Technology Review

Edited at the Massachusetts Institute of Technology

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technology review

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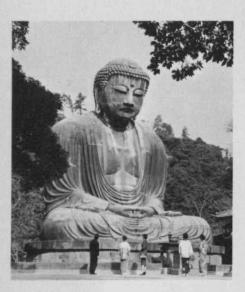
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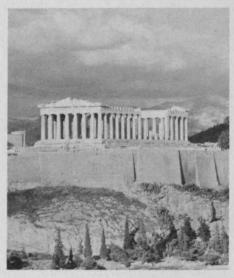


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29 DAYS \$2050

A magnificent tour which unfolds the splendor and fascination of the Far East at a comfortable and realistic pace. Eleven days are devoted to the beauty of JAPAN, visiting the modern capital of TOKYO and the lovely FUJI-HAKONE NATIONAL PARK and placing special emphasis on the great "classical" city of KYOTO (where the splendor of ancient Japan

has been carefully preserved), together with excursions to historic NARA, the great medieval shrine at NIKKO, and the giant Daibutsu at KAMAKURA. Also included are BANGKOK, with its glittering temples and palaces; the thriving metropolis of SINGAPORE, known as the "cross-roads of the East"; the glittering beauty of HONG KONG, with its stunning harbor and famous free-port shopping; and as a special highlight, the fabled island of BALI. Optional visits are also available to the ancient temples of ancient Java at JOGJAKARTA and to the art treasures of the Palace Museum at TAIPEI, on the island of Taiwan. Tour dates include special seasonal attractions such as the spring cherry blossoms and magnificent autumn foliage in Japan and some of the greatest yearly festivals in the Far East. Total cost is \$2050 from California, with special rates from other points. Departures in March, April, May, June, July, September, October and November, 1974 (extra air fare for departures July through October).



AEGEAN ADVENTURE

22 DAYS \$1575

This original itinerary explores in depth the magnificent scenic, cultural and historic attractions of Greece, the Aegean, and Asia Minornot only the major cities but also the less accessible sites of ancient cities which have figured so prominently in the history of western civilization, complemented by a cruise to the beautiful islands of the Aegean Sea. Rarely has such an exciting collection of names and places been assembled in a single itinerary-the classical city of ATHENS; the and Ottoman splendor Byzantine ISTANBUL; the site of the oracle at DELPHI; the sanctuary and stadium at OLYMPIA, where the Olympic Games were first begun; the palace of Agamemnon at MYCENAE; the ruins of ancient TROY; the citadel of PERGAMUM; the marble city of EPHESUS; the ruins of SARDIS in Lydia, where the royal mint of the wealthy Croesus has recently been unearthed; as well as CORINTH, EPIDAUROS, IZMIR (Smyrna) the BOSPORUS and DARDANELLES. The cruise through the beautiful waters of the Aegean will visit such famous islands as CRETE with the Palace of Knossos; RHODES, noted for its great Crusader castles; the windmills of picturesque MYKONOS; and the charming islands of HYDRA and SANTORINI. Total cost is \$1575 from New York. Departures in April, May, July, August, September and October 1974 (extra air fare for departures in July and August).



MOGHUL ADVENTURE

29 DAYS \$1950

An unusual opportunity to view the outstanding attractions of India and the splendors of ancient Persia, together with the onceforbidden mountain-kingdom of Nepal. Here is truly an exciting adventure: India's ancient monuments in DELHI; the fabled beauty of KASHMIR amid the snow-clad Himalayas; the holy city of BANARAS on the sacred River Ganges; the exotic temples of KHAJURAHO: renowned AGRA, with the Taj Mahal and other celebrated monuments of the Moghul period such as the Agra Fort and the fabulous deserted city of Fatehpur Sikri; the walled "pink city" of JAIPUR, with an elephant ride at the Amber Fort; the unique and beautiful "lake city" of UDAIPUR; and a thrilling flight into the Himalayas to KATHMANDU, capital of NEPAL, where ancient palaces and temples abound in a land still relatively untouched by modern civilization. In PERSIA (Iran), the visit will include the great 5th century B.C. capital of Darius and Xerxes at PERSEPOLIS; the fabled Persian Renaissance city of ISFAHAN with its palaces, gardens, bazaar and famous tiled mosques; and the modern capital of TEHERAN. Outstanding accommodations include hotels that once were palaces of Maharajas. Total cost is \$1950 from New York. Departures in January, February, March, August, September, October and November

SOUTH AMERICA

32 DAYS \$2100

From the towering peaks of the Andes to the vast interior reaches of the Amazon jungle, this tour travels more than ten thousand miles to explore the immense and fascinating continent of South America: a brilliant collection of pre-Colombian gold and a vast underground cathedral carved out of a centuries-old salt mine in BOGOTA; magnificent 16th century churches and quaint Spanish colonial buildings in QUITO, with a drive past the snow-capped



peaks of "Volcano Alley" to visit an Indian market; the great viceregal city of LIMA, founded by Pizarro, where one can still see Pizarro's mummy and visit the dread Court of the Inquisition; the ancient city of CUZCO, the Inquisition; the ancient city of CUZCO, high in the Andes, with an excursion to the fabulous "lost city" of MACHU PICCHU; cosmopolitan BUENOS AIRES, with its wide streets and parks and its colorful waterfront district along the River Plate; the beautiful Argentine LAKE DISTRICT in the lower reaches of the Andes; the spectacular IGUASSU FALLS, on the mighty Parana River; the sundrenched beaches, stunning mountains and magnificent harbor of RIO DE JANEIRO (considered by many the most beautiful city in the world); the ultra-modern new city of BRASILIA; and the fascination of the vast Amazon jungle, a thousand miles up river at MANAUS. Total cost is \$2100 from Miami, \$2200 from New York, with special rates from other cities. Optional pre and post tour visits to Panama and Venezuela are available at no additional air fare. Departures in January, February, April, May, Jul November 1974. July, September, October and



THE SOUTH PACIFIC

29 DAYS \$2350

An exceptional and comprehensive tour of AUSTRALIA and NEW ZEALAND, with optional visits to FIJI and TAHITI. Starting on the North Island of New Zealand, you will visit the country's major city of AUCKLAND, the breathtaking "Glowworm Grotto" at WAITOMO, and the Maori villages, boiling geysers and trout pools of ROTORUA, then fly to New Zealand's South Island to explore the startling beauty of the snow-capped SOUTHERN ALPS, including a flight in a specially-equipped ski plane to land on the Tasman Glacier, followed by the mountains and lakes of QUEENSTOWN with a visit to a sheep

station and a thrilling jet-boat ride through the canyons of the Shotover River. Next, the haunting beauty of the fiords at MILFORD SOUND and TE ANAU, followed by the English charm of CHRISTCHURCH, garden city of the southern hemisphere. Then it's on to Australia, the exciting and vibrant continent where the spirit of the "old west" combines with skyscrapers of the 20th century. You'll see the lovely capital of CANBERRA, seek out the Victorian elegance of MELBOURNE, then fly over the vast desert into the interior and the real OUTBACK country to ALICE SPRINGS, where the ranches are so widely separated that school classes are conducted by radio, then explore the undersea wonders of the GREAT BARRIER REEF at CAIRNS, followed by a visit to SYDNEY, magnificently set on one of the world's most beautiful harbors, to feel the dynamic forces which are pushing Australia ahead. Optional visits to Fiji and Tahiti are available. Total cost is \$2350 from California. Departures in January, February, March, April, June, July, September, October and November 1974.



MEDITERRANEAN ODYSSEY

22 DAYS \$1450

An unusual tour offering a wealth of treasures in the region of the Mediterranean, with visits to TUNISIA, the DALMATIAN COAST of YUGOSLAVIA and MALTA. Starting in TUNIS, the tour explores the coast and interior of Tunisia: the ruins of the famed ancient city of CARTHAGE as well as the ruins of extensive Roman cities such as DOUGGA, SBEITLA, THUBURBO MAJUS and the mag-SBEITLA, THUBURBO MAJUS and the magnificent amphitheater of EL DJEM, historic Arab towns and cities such as NABEUL, HAMMAMET, SOUSSE and KAIROUAN, the caves of the troglodytes at MATMATA, beautiful beaches along the Mediterranean coast and on the "Isle of the Lotus Eaters" at DJERBA, and desert oases at GABES, TOZEUR and NEFTA. The beautiful DALMATIAN COAST of Yugoslavia is represented by SPLIT, with its famed Palace of Diocletian, the charming ancient town of TROGIR nearby, and the splendid medieval walled city of DUBROVNIK, followed by MALTA, with its treasure house of 17th and 18th century churches and palaces, where the Knights of St. John, driven from the Holy Land and from Rhodes, withstood the epic seige of the Turks and helped to decide the fate of Europe. Total cost is \$1450 from New York. Departures in March, April, May, June, July, September and October, 1974 (additional air fare for departures in June and July).

EAST AFRICA

22 DAYS \$1799

The excitement of Africa's wildlife and the magnificence of the African landscape in an unforgettable luxury safari; game viewing in the wilderness of Kenya's Northern Frontier district at SAMBURU RESERVE; a night at world-famous TREETOPS in the ABERDARE NATIONAL PARK; the spectacular masses of



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Rates include Jet Air, Deluxe Hotels, Most Meals, Sightseeing, Transfers, Tips and Taxes.

Individual brochures on each tour are available, setting forth the detailed itinerary, departure dates, hotels used, and other relevant information. Departure dates for 1975 are also available.

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Articles

The Origin of the Planets and Satellites

John S. Lewis

A theory which comprehends the features of the solar system which we observe-the planets and their satellites, meteorites, and asteroids-commands attention as an exercise in modelmaking as well as an excursion into

Designing Earthquake-Resistant Structures

James H. Williams, Jr.

A building's survival in an earthquake depends not upon its strength but upon its capacity to dissipate the energy of the moving earth. Designing structures to cope with tremors is less a problem than determining the levels of protection to be sought

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Edward H. Bowman

Today's investor is increasingly conscious of the social performance of the corporations in which he shares ownership. But his interest-like that of his company-depends upon an elusive balance of private and public good for which guidelines are largely absent

Institutions for Urban Transportation Frank C. Colcord, Jr.

Urban transportation is seldom the responsibility of a single agency or level of government; its very heterogeneity is one reason for the lackluster record of transit planning and operation in the U.S.

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Photograph of the Lagoon Nebula in Sagittarius by the Hale Observatories, ©California Institute of Technology and Carnegie Institution of Washington; design by Ralph Coburn

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Institute Informant

To everyone's surprise-including its builders'-BURD is shown airborne; and other events of the summer

The First Line

Starting a New Year

True to the traditions of academe from which we come, *Technology Review* begins the new year in the fall—not in midwinter. As we start Volume 76, therefore, we pass a milestone and record three reasons for celebration:

—Ian C. T. Nisbet, Associate Director of Massachusetts Audubon Society's Research Department, has joined the ranks of the Review's regular contributors. We invited him because we suspect that emotionalism instead of rationality often characterizes today's discussions of technology in relation to the environment, that scientific substance may be enlightening. His first contribution (pp. 16-17) suggests that "Environment/Technology" will indeed be a department worth watching. Dr. Nisbet's





S. J. Neustadtl

I. C. T. Nisbet

degrees are from Cambridge University (physics); he came to the U.S. in 1957 to work in aeronautical and mechanical engineering at Cornell and M.I.T., returned to Cambridge, became Senior Lecturer in Physics at the University of Malaya, and finally settled with Massachusetts Audubon in 1968. Many readers will have seen his lyrical descriptions of common and roseate terns in the July, 1973, issue of National Geographic magazine.

—Earl Woltz, whose column on bridge appears for the first time in this issue of Technology Review (p. 73), is an M.I.T. graduate student in chemical engineering. His approach to the game—and to his column—is through mathematics: how probability analysis enters championship

—Sara Jane Neustadtl has come from the University of Illinois (Champaign-Urbana) to join Technology Review as Assistant Editor, While studying in the College of Communications Miss Neustadtl was Editor of the College of Engineering news-letter, "Engineering Outlook," and it is in particular her success with the latter which brought about her migration from midwest to east.



Letters

Solar Energy for Survival?

I was very pleased to read Mr. Helversen's comments (Letters, May, p. 4) on Earl Cook's article, "Energy for Millenium Three" (December 1972, pp. 16-23). In view of the N.S.F./N.A.S.A. solar energy panel report, "Solar Energy as a National Energy Resource," it is obvious that Dean Cook's thinking, that solar power would require too much capital or material to be economically practical, belongs to the past. This is not what the solar energy panel report implies. In fact, it appears that solar energy would be cheaper and far less risky to the ecology of the planet than either fossil fuel or nuclear energy.

In his reply Dean Cook quotes Confucius, "Study the past if you would define the future." Only in this case I feel a study of the past will lead any intelligent person to conclude that what the world desperately needs is a change in our fundamental approach to energy production, not just more of the same kind of energy policies that have created the present ecological mess. This is not just a matter of economics but rather of survival for humanity. I am afraid that Dean Cook's type of thinking may be leading humanity in the direction of dinosaurs.

What we need is to pour a massive amount of capital into solar energy as soon as possible. This could be accomplished by means of a simple tax incentive bill that would make investment in solar energy much more attractive for private individuals or corporations.

I hope that the *Review* might make its recommendations for solving the energy crisis more consistent with the real needs of humanity rather than the continued great profits of the present energy cartel.

James R. Poole, M.D. Wheaton, Minn.

Dean Cook responds:

It is important to point out a fact that seems consistently ignored: reports such as the N.S.F./N.A.S.A. report on solar energy research, cited by Dr. Poole, should not necessarily be taken as objective assessments; they are usually prepared by persons who have a strong personal or crganizational interest in having the recommended research funded and are therefore persistently optimistic about the pay-off potentials.

Out on a Limb for Gasoline

Solar energy may be the last word but you cannot put it in a car, and the shortage of gasoline is the critical item in today's living. Our lives and economy are geared to the internal combustion engine, and we have drive-in movies, banks, restaurants, and of course the neighborhood supermarkets. Without gasoline we are out on a limb.

Ralph M. Shaw, Jr. Beverly, N.J.

Bohr Was a Dane

On page 65 of your July/August issue, someone mentions "Neils Bohr" twice. Bohr

was a Dane, and there is no Danish name like "Neils." His first name was Niels. Seems a small thing, but an immense number of mistakes are made—like this one, and more significant, too—whenever American authors and writers run into expressions in foreign languages, or into foreign names.

Erling Norlev Alsea, Ore.

Typoetry
Perhaps you will allow the following comment on your June issue, page 3, column 1, line 6:

A high capacity Continental railroady May be Far better though to see A page from typos free.

Frederic W. Nordsiek New York, N.Y.

The Oil Railroads

Your account of my research (see "The Oil Railroad," Trend of Affairs, March/April, p. 71) on North Slope oil and gas transport failed to emphasize my main point, namely that the new technology of gas liquefaction, coupled with the well-developed unitrain technology, now makes feasible the concept of non-stop oil-and-gas unitrains from the Arctic. The remarkable savings in shipping gas in liquefied form would more than justify the railway over any pipeline. In addition you cited the transportation cost of gas as "25 cents per million cu. ft." instead of "25 cents per million B.t.u." which I had reported.

My proposal is obviously related to Richard A. Rice's general approach ("How to Reach That North Slope Oil," June, pp. 8-18), which is essentially the same as the 1972 report of the Canadian Institute of Guided Ground Transport. My addition of the proven concept of L.N.G. tankcars, with a non-stop self-propelled train, makes the whole scheme economically attractive. In this matter of solving the problems of energy and energy resources for the 21st century, we should—at the very least—have enough imagination to apply 20th-century methods instead of trying to resuscitate technology, such as present railroad rolling stock and operating methods, that has steadfastly resisted change since the 19th century.

Robert L. Whitelaw Blacksburg, Va.

The author is Professor of Mechanical and Nuclear Engineering at the Virginia Polytechnic Institute and State University.

The System Mode

A primary issue faced by our society is our understanding of the system mode, where traditional, habitual ways of doing business or thinking persist. Several items in recent issues of *Technology Review* seem to be significantly interrelated to this comment.

The work at M.I.T. for the Club of Rome (see "Counterintuitive Behavior of Social Systems" by Jay W. Forrester, January, 1971, pp. 52-68) examined the system

Continued on p. 8

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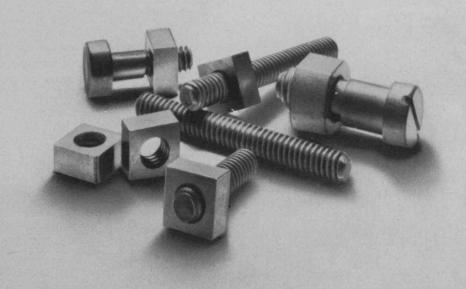
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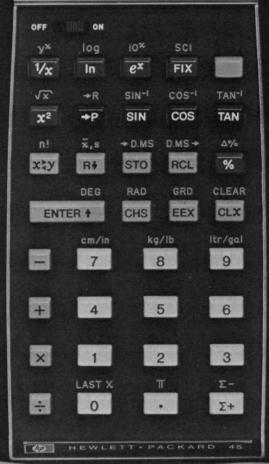
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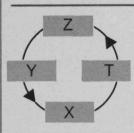


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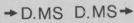
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- Arc sine Cosine Arc cosine Tangent
- Arc tangent

- Common logarithm Natural logarithm Common antilogarithm
- Natural antilogarithm

- Serial calculations
 Mixed serial calculations
 Chain calculations
- Mixed chain calculations

- The square root of the number
- displayed
 The square of the number
 displayed
 The reciprocal of the number
- displayed
 The raising of any positive number to any power
 The factorial of positive integers
 Percentage and percent
 differences

- Sum of the squares The mean of entries made with the " Σ +" key The standard deviation of entries with the " Σ +" key

Automatically convert:

- The decimal angle in any of the angular modes in the display to degrees/minutes/seconds
 The degrees/minutes/seconds angle in the display to a decimal angle
 Polar coordinates to rectangular

- coordinates to rectang coordinates Rectangular coordinates to polar coordinates Centimeters to inches

- Simultaneously accumulate two sets of entries for statistical and vector calculations
 Allow for deletion of erroneous

- entries
 Recall the last argument of a
 calculation to check for accuracy
 Display the constant Pi at the
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Continued from p. 4

mode as carefully as it could, and in the book The Limits to Growth Dennis Meadows et al took great pains to explain that their time-domain plots were a convenient and easily-grasped representation of the system mode, at least as it appeared in their model. I am more than a little surprised, therefore, to see their work criticized (and supported) in terms of its predictions. In fact, I have yet to see a review, a critique, or an extension of the work for the Club of Rome wherein the very important distinction has been made between prediction and display of the system mode. Only Dennis Meadows' group, as far as I know, has penetrated deeply enough into the problem to grasp the role the multiloop feedback system itself plays in the overall instability. It seems strange that many do not understand Professor Forrester's remarks to the effect that one can have a fine and exact grasp of the impor-tant factors and how they influence each other from one informational mode to the next and yet have virtually no worthwhile feeling for what must be done to compensate a given runaway socio-economic system. Barry Commoner's book, The Closing Circle, when read back to back with The Limits to Growth, displays this problem of evaluating the causes of undesirable emergent behavior from a complex system. Professor Commoner is probably the best informed and most knowledgable scientist concerned with the disasters evolving from and upon our society, and the system complexity perturbs even his analysis.

The recent article on North Slope oil ("How to Reach that North Slope Oil" by Richard A. Rice, June, pp. 8-18) touches on one facet of this broader problem. The current petroleum crisis was predicted by M. King Hubberd in about 1949. There were many over the years who questioned his detailed data, and, while his predic-tion was loose, it was precise as it reflected time domain behavior of a crucial node of the broader socio-economic system. As can readily be grasped, the exponential function describing use of a resource dominates any finite resources, and thus these "flat earth economics" are automatically unstable. The problem is whether anything can be done about it that we'd be willing to live with and which hence might not be subject to disruption because people would reject the solution. As it stands now, people seem locked into growth as if it were good in itself. This, if true, makes sensible change very hard.

Consequently, when a few years ago I asked a distinguished colleague of mine—an economic geologist—how much oil there was in the Prudhoe Bay field, he responded by saying, "None." He explained that the oil would only encourage us in our wasteful utilization of petroleum and other resources with a consequently greater collapse to come; except for a small time delay, the ultimate collapse would still occur. He said if we could learn to use our resources at a steady rate, then the North Slope discovery could be assigned a positive value. As it is, one could even justify saying its value was negative

since the ultimate collapse would come from a higher and even less tenable level of use because of that discovery.

Respect for the world in which we live—"environmental protection," one of Professor Rice's "new set of priorities"may be one of the crucial system changes that can stabilize our overall system if we learn our lesson in time. We conservationists have been hammering that line for decades, although often not explicitly. If the conservation pressures have provoked an artificial petroleum or energy crisis (if you can call it an artificial crisis where we import 30 percent of our petroleum and will soon import 50 percent or more) and the oil companies have conspired to exacerbate it to force acceptance of the Trans Alaska Pipeline System, then this will be ultimately beneficial to our long-range stability, providing that we start facing the unstable system mode so graphically displayed in the Club of Rome studies.

Ínstead of facing such problems squarely, there is evidence our political and economic leaders are seeking ways to plunge into the deepening spirals of exploitation of tar sands and oil shale and even a return to coal—all of which hold prospects of total devastation of massive portions of Canada and the United States.

It would seem past time to assemble overviews of the problems and implica-tions of this growth syndrome. Professor Rice's speculation of the "Impact on Alaska's Economy" is conventional in that the desirability of growth, exploitation, and development is taken for granted. Yet in his "A Longer-Term View," he is clearly aware the vast Prudhoe Field will only fuel the United States for two years (around 1985). Surely such a prospect should frighten anyone who contemplates what lies beyond 1985. The Meadows evaluation of the system mode must constitute a form of technology assessment of T.A.P.S.; we should reject any technology that could develop into so much jeopardy for the whole society as continued explosive growth in energy use (aided by T.A.P.S.) will do. My colleague's assignment of zero overall worth to the Prudhoe Bay Field seems less and less surprising as events unfold.

Richard C. Sill Reno, Nev.

The writer is Professor of Physics and Chairman of the Environmental Studies Board at the University of Nevada.—Ed.

Professor Rice responds with thanks for Professor Sill's letter: We simply do not have the sophistication here to be able to incorporate such important but quantifiably difficult concepts as the interlocking economics and ecologies in the style of the Club of Rome study. It is in fact just the other way around: we hope that such planners and economists can incorporate our type of work into their forecasts.

We did not assume it was either good or bad that Prudhoe oil *per se* be used in the U.S. We only compared certain measurable parameters for the three prime corridors by which the oil might be removed.

Energy Research Is Needed!

I am sorry to see that Edward E. David, Jr. (see "Energy: A Strategy of Diversity, June, pp. 26-31) has fallen so easily into the trap set by the energy industry, concluding that the only way to solve the energy crisis is to increase supply.

As so many recent articles in Science and Technology Review have shown, very substantial energy savings can be realized over the next decade by following deliberate conservation strategies. A few of the most obvious examples are: reducing gasoline consumption by almost 40 per cent by using compact or subcompact cars; taxing the weight or power of automobiles and increasing gasoline tax which could create additional revenues to be used for public transit systems; enforcing regulations to properly insulate homes and thus save almost 50 per cent of the energy used in an inadequately insulated home; banning inefficient appliances such as certain air conditioners; altering the rate structure for commercial power customers; and changing lighting levels in commercial buildings. As architect Richard Stein has noted, at least 25 per cent of the energy consumed in commercial buildings is wasted.

It is simply not true to say that new technology will not help over the next 10 or 20 years. Consider the following ex-

amples:

—If this nation went over to gas-cooled reactors instead of pressurized or boiling water reactors, this would be an immediate increase in efficiency from 33 to 40 per cent

—An electric car, using energy supplied by such a gas-cooled reactor, would be at least 50 per cent more efficient in terms of miles/k.w.h. than the gasoline car of today.

—We know we can make high-energy batteries in the laboratory today, and we ought to be able to make them commercially within 10 years if we make a N.A.S.A.-type effort to do so.

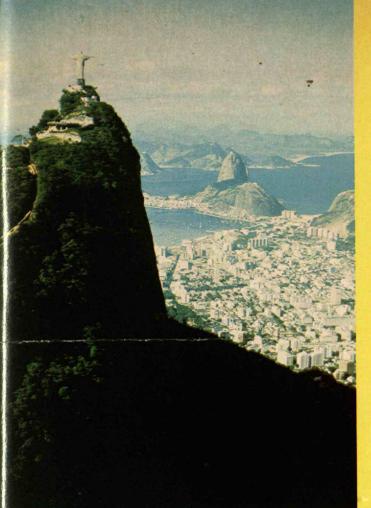
The statement that our current environmental concerns contravene energy conservation is true only to the extent that we have deliberately chosen strategies that will reduce efficiencies. Nor is it accurate to say that safer cars must be inefficient.

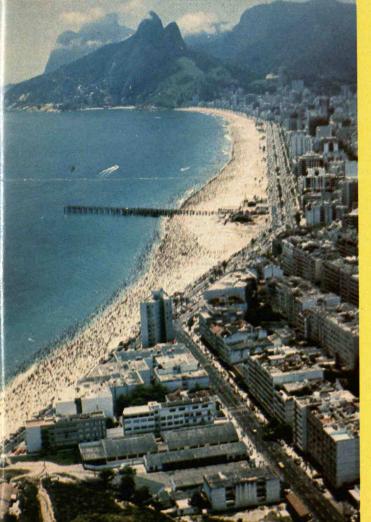
Finally, I am sorry that Dr. David says that environmental requirements for strip mining would seriously increase the cost of coal. E. A. Nephews and his co-workers at Oak Ridge National Laboratory have calculated that \$5,000/acre is a reasonable figure for reclamation of strip-mined land; this would add 0.5 mill/k.w.h. to a typical electric bill, a 1.4 per cent increase.

Vikram Dalal Princeton, N.J.

Dr. David responds:

The energy situation is complex and controversial. There is room for many different viewpoints. However, the situation cannot be approached responsibly with questionable contrasts such as new energy sources or energy conservation. Based on federal projections of future fuel availability, new sources of energy will be necessary in the years ahead regardless of whether the growth of energy demand is positive, negative, or zero. (It is most likely to be positive, but probably at less







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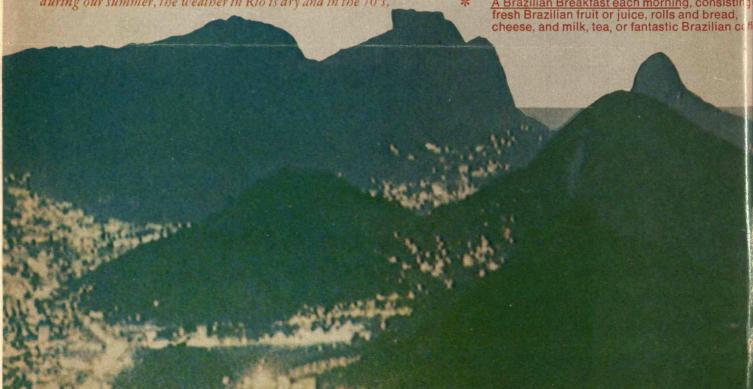


For less than half the normal airfare alone, we're going for a week-long vacation to the fun capital of an entire continent and "the most beautiful city in the entire world" (Richard Halliburton, Book of Marvels). This is the famous, pearl-white city etched by soaring mountains and jungle forests against the blue of the South Atlantic, with a year-round perfect climate* and a year-round carnival spirit, the world's most exquisite beaches, a treasure trove of precious gems, and unlimited, all-night entertainment. Here are gorgeous girls from Ipanema, minstrels singing in the street, colorful dancers of Samba and Bossa Nova, and voodoo witchdoctors in outlying favelas. We can idle here in open-air cafes, stroll the serpentine mosaic walks, enjoy the world's best steak and coffee, dance'til dawn in a two-thousand seat nightclub, or browse in an endless array of boutiques. Onetime capital of a Portuguese Empire, with architecture and culture of a colonial past, it is now the spiritual capital of a progressive nation whose independence, like our own, was inspired by Thomas Jefferson.

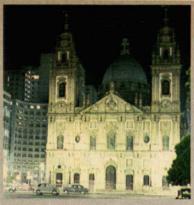
During our winter, the weather in Rio is like our summer, and during our summer, the weather in Rio is dry and in the 70's.

Our trip is planned to include:

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- First-Class Hotel Accommodations for seven nights at the Guanabara Palace Hotel, one of Rio's largest (22 floors with 306 rooms) hotel Our rooms all have double or twin beds, air conditioning, telephone, radio, and private bathroom with bath, and shower; they are large, clean and appointed with traditional Brazilian furnishings. The Guanabara Palace Hotel is centrally located, facing Rio's beauti Candelaria Church (pictured above), and is b ten minute (\$1.00) taxi ride from Rio's famous beaches (a city bus [\$.10 per passenger] leavevery few minutes from the hotel's entrance). The Guanabara Palace's facilities include an international restaurant, bar, recreation loun barber shop, and 24-hour room service.
- A Samba Welcome Party for the entire group featuring live performers in native Brazilian costume, a chance to imbibe the musical spir
- A Brazilian Breakfast each morning, consistin fresh Brazilian fruit or juice, rolls and bread,





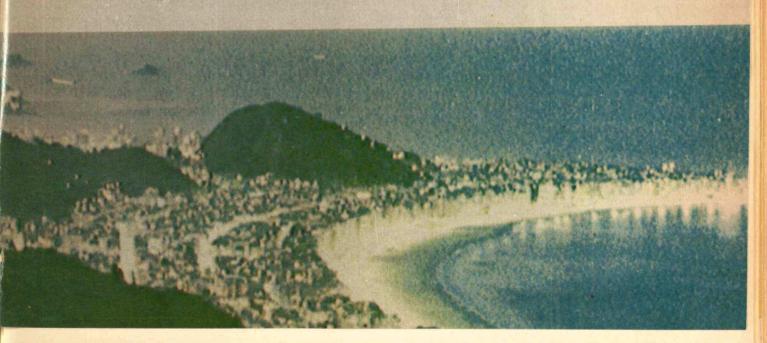






Two Half-Day Motorcoach Sightseeing Tours (one in he morning and one in the afternoon), with expert English-speaking guide, will show us Rio's important places such as: Sugarloaf Mountain and Corcovado 2,400 feet, surmounted by 120-foot Statue of Christ); the Guanabara Palace (now the Governor's home); Copacabana, Ipanema, Flamengo and Lebion beaches; Praca da Gloria (residence of the Archbishop); the beautiful Quinta da Boa Vista Park (formerly the Emperor's private park) with Rio's Aquarium and its Zoological Gardens (world's largest collection of tropical birds); The Botanical Gardens (7,000 flower species) approached by the exquisite Avenue of Royal Palms; Flamengo Park (largest city park in South America); the Cinelandia Entertainment Quarter (Rio's Times Square with a score of theatres); the Opera House, Comic Theatre and Municipal Theatre; Tijuca Forest (fantastic jungle rain forest where monkeys play) with the Paul and Virginia Grotto and the Mayrink Veiga Chapel (paintings by Portinari); Dogface Hill with imposing Fort Sao Joao; the Museum of Modern Art (fabulous Picassos, Braques and Matisses); the National Museum of Fine Arts; the fascinating Museum of the Indian; the Geographic Museum (showing Brazilian artifacts and products); Itamaraty Palace (containing antiques, tapestries and objets d'art); Maracana Stadium (world's largest capacity: 200,000); the 18th Century Church of Nossa Senhora da Gloria (with its Bible scenes in blue tile); the lovely doubleturretted Portuguese Church of Santa Luzia; the exquisite Church of Sao Bento; the Botafogo quarter with its interesting Synagogue; beautiful Guanabara Bay: Arched Viaducts (on the Roman model); Avenida Presidente Vargas (Rio's Champs-Elysees); the elite Jockey and Yacht Clubs: the Reboucas Tunnel (South America's longest); Praca Paris (with its French gardens); and much more.

- * A Two-Hour Cruise in Guanabara Bay will take us by ferryboat from 15 November Square round trip to exquisite Paqueta Island (called "Lovers' Island"), the most beautiful of the Bay's 150 islands, with its lovely beaches and fanciful horse-drawn carriages.
- * A Brazilian Beef Dinner, one evening, at one of Rio's Churrascarias (native translation of the American steak house), our chance to sample world-famous Brazilian meat in a delicious meal, including after-dinner Brazilian coffee.
- * A Visit to a Gem-Cutting Workshop, one morning, will show us the processes which make Brazil the jewelry treasure chest of the world. During the visit, we shall receive a complimentary collection of gem-stones in their natural state.
- * Special Shopping Discounts have been arranged for us, particularly at Mesbla S / A, Rio's most prestigious department store. A chance to save money on our purchases of famous Brazilian leatherware, woodcarvings, and fashion.
- * A Map of Rio and a Guide to Rio will be provided to each passenger upon arrival at the hotel, helpful information to facilitate our plans.
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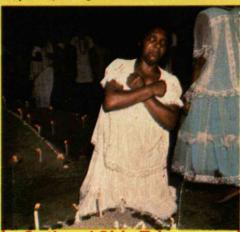
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than the 5 to 6 per cent/year rate of the past decade.) New sources will be required because of the changing mix of available fuels-a smaller proportion of light and gaseous hydrocarbons, more heavy hydrocarbons and nuclear fuels. There will also be more reliance on synthetic fuels and unconventional and less polluting sources such as solar and geo-thermal. Again, this shift in sources will be required regardless of demand dynamics. Thus work on new sources is vital regardless of conservation efforts-which are also a necessary part of the nation's energy strategy. It is not an either-or situation.

Similarly, on the strip-mining issue, it is not a question of strip mining with reclamation or without. Some proposed laws would prohibit strip mining altogether, but this stance is not likely to be sustained by Congress. However, the feasibility of reclamation in arid lands such as are found in the western United States and on steep slopes as in parts of the Appalachians is open to question. In wet, flat terrain such as that near Cologne, Germany, where the Rhine Brown Coal Co. has done deep open pit mining, reclamation has worked well for years and is not unduly costly.

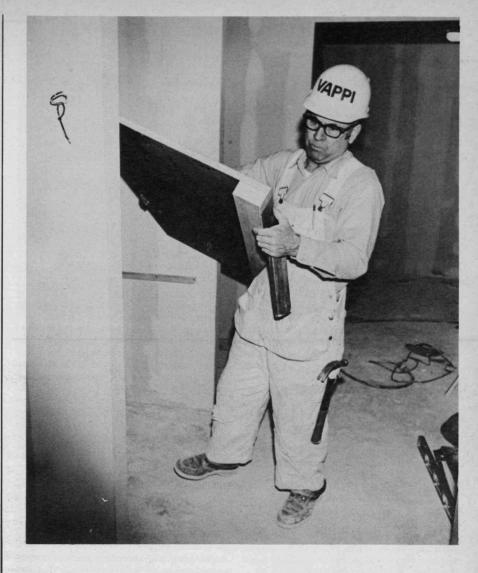
The potential energy economies in higher efficiency electrical power generation, better home insulation, electricallydriven cars, and better-designed appliances and transportation have been subjects of much discussion. My own preference in such matters is to give the consumer a wider variety of informed choices instead of placing faith in obtaining prudent and wise legislation (which is all too infrequent). Labelling to inform the consumer as to the trade-off between firstcost and operating and maintenance costs on each prospective purchase would be

It is incorrect to tie gasoline savings to different versions of the internal combustion engine. The greater gas consumption of 1973 cars over those of 1968, for example, is largely due to increased weight. Less than one-third of the increase is due to pollution control equipment. The single and dual catalyst systems for 1975 and later will give better gasoline mileage than the current models, which appear to be the

low point in performance. High-density, high-energy batteries are in prospect-and in a shorter time frame than 10 years. Currently one of the most promising is the zinc-chlorine hydrate battery pioneered by Hooker Chemical, a subsidiary of Occidental Petroleum. But there are others, such as sodium-sulphur (NSF-Ford-Utah State-RPI); lithium-sulphur (Argonne National Labs-NSF), and nickel-zinc or nickel-iron (Gould-Westinghouse). Just which of several possibilities which now seem promising can power particular classes of vehicles remains to be seen; will appear in much less than five years, and a "N.A.S.A. approach" is not needed.

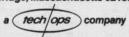
What is implied by that notorious term, "N.A.S.A. approach"? If that means a wellfunded, carefully-planned program of technology development and engineering, no one would argue—provided adequate basic knowledge is available. But the usual

Continued on p. 78



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Comments by E.L. Patton, President, Alyeska Pipeline Service Co.

Pipeline vs. Rail to Alaska

The following is a letter from E. L. Patton, President of Alyeska Pipeline Service Co., Bellevue, Wash., commenting on "How To Reach that North Slope Oil," by Richard A. Rice (June, pp. 8-18). The Editors have asked Professor Rice to comment on the letter, and his responses are shown in italics following the portions of Mr. Patton's communication to which

they apply.-Ed.

I am aghast at the poor quality of re-search and staff work by Richard A. Rice. In addressing a subject as complex and important as the one at hand, an engi-neering professor should commence with hard facts, should clearly dilineate his assumptions and point out the sensitivity of his final conclusions to errors in assumptions. I fear Professor Rice's students are in for a rude shock when they reach the real world: if, as a young engineer, I had presented such a poorly founded paper to my employer I would no doubt have been summarily ridden out of town on a rail system of considerably more substance than that conjured up for North Slope oil.

Here are some facts: 1. The proposed Trans Alaska Pipeline System (T.A.P.S.) with its associated tankers is designed to deliver North Slope crude oil to the U.S. West Coast, not to Chicago or any other inland region. The West Coast is a ready and waiting market for the initial capacity of the T.A.P.S., and that market will grow to the ultimate capacity (2,000,000 bb1./day) of the system by 1980. The West Coast is the closest market to Alaska; it can be reached at lower cost than any other. Therefore it is the most efficient market so far as the State of Alaska, the oil companies, the consumers, and U.S. resource costs are

2. The total gross facilities cost of the T.A.P.S. system, including tankers, is \$5.2 billion based on definitive, detailed engineering estimates. The pipeline and terminal portion to be financed by the oil companies involved is \$3.6 billion. Tankers, the majority of which will be financed by the maritime industry and built as needed, will cost \$1.6 billion. These figures include the cost of working capital. There is no natural gas line associated with the T.A.P.S., from Seattle to Chicago (91 per cent of the North Slope oil is destined for California, with only 9 per cent for the Puget Sound area), and no "lower 48" port and terminal facilities are included because these already exist to

handle the foreign crude imports on which the West Coast is now dependent.

The energy shortage as it is actually developing in the United States is in the Chicago-Minneapolis-Denver sector, not mainly on the West Coast; this is predicted by almost all petroleum economists. The coastal regions are to be served by supertankers importing overseas oil; the southern United States has our largest reserves and is close to Venezuelan oil; the Seattlearea supply can be augmented from new discoveries near the Canadian Rockies and in Montana; but the Denver-Chicago area, as more thorough studies have shown, has the last proximity to larger discoveries or overseas delivery.

Unfortunately, all transport planners are aghast at the catastrophically gross underestimation which placed the original cost of T.A.P.S. at \$900 million. If the final investment for the pipeline and Alaska terminal will be \$3.6 billion, this is an error of at least \$2.5 billion due to poor engineering and surveying and inadequate consideration of field conditions. T.A.P.S. would have been well advised to use less positive language in their 1968 projections-which would then have more appropriately read, "It is possible that we might construct a 48-in. pipeline to the North Slope for \$900 million to tap the probable 15 billion (and possibly 25 billion) barrels of petroleum reserves.

This sober language could then have been amended in 1972 to read "It now seems probable that it will cost about \$3.2 billion to reach North Slope with a 48-in. pipeline to tap proven reserves of 9.6 million barrels." Such modest language by engineers is a courtesy to investors and

planners.

The stated total investment for the T.A.P.S. tanker delivery system of \$5.2 billion (including \$3.6 billion for the pipeline and Alaska port) sounds reasonable and is on the same order as the \$5.1 billion listed in our report.

The essential companion gas pipeline down to the Mackenzie is likewise listed at about \$5 billion. We did not mean to imply that Alyeska was financing this also.

Authoritative articles in the Oil and Gas Journal report that present Atlantic and Pacific tanker unloading facilities are inadequate for the future.

3. The lowest-cost form of long-haul

crude oil transportation under normal environmental conditions is large tankers. The next lowest cost is large pipelines. Each of

these forms, on a ton-mile basis, costs only a fraction of rail costs. While it might be conceivable that a built-for-the-purpose rail sustem could lower the ton-mile rail cost to no more than three to four times that of the pipeline-tanker system, the fact is that existing rail systems have tonmile costs five to 10 times those of pipe-lines and tankers. If, as Professor Rice claims, rail has the cost advantage, the existing oil pipeline network (over 200,000 miles in the U.S.) would not have come into being. The very reason Southern Pacific went extensively into the pipeline business was that it could not attract oil freight to its rail network. Rail is superior only to trucks. The tanker leg from Valdez to the West Coast is entirely conventional and is one of the reasons for getting North Slope oil to an ice free port via the shortest possible pipeline route. The per-barrel cost (including amortization of the T.A.P.S. and tanker system to Los Anof the geles) is \$1.13.

Our information on projected oil delivery costs comes from a study published by the President of the Humble Oil Pipeline Co., who sees unit trains eventually yielding costs in the \$.0025 to \$.0040 perton-mile bracket. These are for ultra large, modern unit trains on special rights-of-way, and they contrast with current costs of \$.004 to \$.006 per ton-mile for coal.

Normally, in the U.S. proper, such costs would not be competitive with oil pipelines at \$.0015 to \$.0025 in the large di-ameters—and certainly not with supertankers. However, in the Arctic environment, which is far more hostile to pipelines than trains, T.A.P.S. is faced with costs approaching 50 cents/bbl. for the 800mile movement instead of the traditional 20 cents. This is \$4.20 per ton or \$.005 per ton-mile—higher than many recent unit train contracts in the lower United

As for our 200,000-mile oil pipeline network in the U.S., of which only 100,000 miles are of a larger diameter, it is interesting to note that as recently as 1965 this network was only capitalized at about \$3 billion. Thus \$3 billion more of capiitalization for only about 1,000 more miles seems disproportionate. This disproportionate cost at \$4 million per mile (versus \$400,000 per mile for 48-in. lines further south) is responsible for our view of T.A.P.S.' uneconomic outlook.

4. The ice-breaker/tanker mode was not found by the sponsors of the Manhattan

tanker project to be cheaper than T.A.P.S. Had it been, those same sponsors would obviously not have put their money behind the Alaska pipeline.

This is also what our report implies. The

Manhattan idea was even more expensive

and hazardous than T.A.P.S.

5. The total capital cost of a 2 million bbl/day crude oil line and a 4 billion cu. ft./day natural gas line from Prudhoe Bay via the Mackenzie Valley to Chicago (3,200 miles) is not \$5.6 billion as stated by Professor Rice, but \$12 billion (\$7 billion for oil and \$5 billion for gas). The per-barrel cost of moving oil via this route is \$1.51. The unit cost of gas movement is not known to me, as Alyeska is not in-

volved in the gas project.

We used cost increments for the Mackenzie Valley pipelines based on the latest estimates for gas and oil pipelines as released by their sponsors. These are the realistic figures for costs if the two lines are built on a combined basis. The figures cited by Mr. Patton are for two separate systems-like adding the costs of two two-lane highways in separate locations instead of making a special estimate for a 4-lane highway on one of the two routes. Incidentally, the \$7 and \$5 billion figures cited are newspaper-type information, not those of the engineers involved; the engineers' figures are \$5 and \$3 billion, respectively.

6. All of Professor Rice's cost data are derived from preliminary estimates with accuracy of the order of those which led to the belief in 1969 that the cost of T.A.P.S. would be \$900 million. As detailed soils investigations, route selection, and engineering progressed, pipeline cost increased threefold. Without doubt, the same kind of increase also would apply to Professor

Rice's railroad.

This paragraph implies we may have had something to do with the gross misestimation of early T.A.P.S. planning. This is not true, we were in no way involved. It does not follow from the T.A.P.S. experience that rail costs must be similarly un-derestimated. Current rail construction costs of the British Columbia Railroad toward Dease Lake and costs of the interprovincial 48-in. pipeline sections (both in the \$400,000 to \$600,000 per-mile bracket) are exactly in the price ranges we forecast for those latitudes and terrains. The Mackenzie Valley costs we used are already hedged to 1972 levels for isolated access, terrain, and permafrost conditions.

7. The 10-billion-barrel proven re-serves at Prudhoe Bay have a maximum efficient producibility of 1,500,000 bbl./day At that rate the presently proven reserves would last 18 years, so further discoveries would be required to fill the pipeline to its maximum 2,000,000 bbl./day capacity. Naval Petroleum Reserve No. 4 on the North Slope has proven reserves of 600 million barrels, not 20 billion as stated by Professor Rice. Should the Navy desire to utilize the Alaska pipeline, that would take up about 100,000 bbl./day of the line's spare capacity. Contrary to Professor Rice's speculation, there are no presently proven oil discoveries of commercial size between the Alaska/Canadian border and Mackenzie Valley.

The U.S. Navy has already released figures that its proven reserves could sup-





The Trans Alaska Pipeline bringing oil from the new fields in Prudhoe Bay is to terminate at the port of Valdez. Two reasons for that choice, writes E. L. Patton, President of Alyeska Pipeline Co.: it is the northernmost ice-free port in Alaska, "one of the world's truly great natural harbors";

and the pipeline would parallel the Richardson Highway (above) through Thompson Pass in the Alaska Range. Opponents remain uneasy: Will oil affect Valdez' prosperous salmon fishery (bottom)? (Photos: H. Armstrong Roberts and Ewing Galloway)

ply the United States with 2 to 3 million barrels daily if necessary. Beyond this, the Navy is reluctant to confirm precise reservoir sizes, but geologists have interpreted

8. Professor Rice states that the main drainage patterns of Alaska have an eastwest orientation. Perhaps so, if the Yukon is accorded the distinction of being the main drainage pattern; but the fact is that the vast majority of streams in the areas of Alaska and Canada under discussion have a north-south orientation. Professor Rice's favored rail route along the coast of the Beaufort Sea from Prudhoe across the Arctic National Wildlife Range to the Mackenzie crosses dozens and dozens of

drainage systems with attendant bridging problems and byproduct environmental effects. The casually mentioned semifrozen peat bog and muskeg in Canda also represents a major challenge to rail bed stability.

Some 70 to 80 per cent of Alaska's water does drain to the west and southwest. The half-dozen streams on the North Slope crossed by the Mackenzie alignment represent 4 per cent of the state's water flow. If they were contaminated (since they are crossed near tidewater) only 1 per cent of Alaska's flowing water would be affected.

9. The initial survey for the T.A.P.S. did indeed favor, as Professor Rice states,

In his original article in Technology Review (June, 1973, p. 11), Richard A. Rice wrote that harbor conditions in the Valdez Arm of Prince William Sound would be "crammed" and that "the task of coordinating frequent tanker movements through the 50 miles of straits and islands to the south make this alternative problematical." Responding to reassurances from E. L. Patton, President of Alyeska Pipeline Co., in the accompanying letter, Professor Rice now prefers the word "constrained," referring to the "narrow throat of the harbor through which it will be difficult to manage supertankers under conditions of wind or fog." Mr. Patton, on the other hand, is confident that "the present state of the maritime art" is adequate to bring vessels through "the six-mi.-wide deepwater Hinchinbrook Channel at the entrance to Prince William Sound.



the use of Anaktuvuk Pass for the pipeline crossing of the Brooks Range because it was the lowest pass in the vicinity of a desired pipeline routing. However, the detailed soils investigation in Anaktuvuk revealed massive concentrations of ice in the permafrost; so the routing was shifted to the much higher and drier Dietrich Pass where, contrary to Professor Rice's assertion, savings in construction cost justify the increased operating cost of the higher elevation. The much lower caribou count in Dietrich was a byproduct benefit, but not the reason for the move.

We must continually emphasize that the 40-in. Trans-Alpine Pipeline from the Adriatic to Bavaria has three 4.5-mile tunnels through the Alps under conditions far less severe than the exposed Dietrich Pass

crossing.

10. Except on flat or nearly flat land, the proximity of a railroad is not as beneficial as a road to pipeline construction. With a rail bed limited to 1 per cent grades and a pipeline moving up and down 30 per cent grades, there would, of course, only coincidentally be locations where the pipeline could be worked from a rail bed. Furthermore, why should a pipeline be penalized by being limited to the same large radius of curvature as a railbed? The advantage of road over rail in non-flat terrain is that the road can be kept much closer than rail to the actual pipeline route.

The Mackenzie Valley route provides

mainly straight and level stretches for parallel construction, so the comment does not pertain here. The cost savings come even more from access and freight bills than from routeway commonality.

11. The Alaska pipeline was routed to Valdez rather than to a port in the Anchorage area because there are many more advantages-as previously stated-for the pipeline to be near a road (Richardson Highway) than near a railroad, and because Valdez is the northernmost ice-free port in Alaska, in addition to being one of the world's truly great natural harbors. Tidal action at Valdez is one-third to onehalf that of other ports considered (tidal current is negligible), the terminal site has very deep water, and the site is almost completely screened from surface winds. Far from being crammed, as stated by Professor Rice, the 36-sq.-mi. area of the port proper will, at maximum pipeline capacity, be called upon to load an average of 2.7 ships per day. If we double that for arrivals and departures, the traffic density becomes something like 0.15 ships per square mile per day-not very crammed. The entrance to Valdez Harbor has a minimum deepwater width of 3,000 feet as compared with about 600 feet for most U.S. East and Gulf Coast ports, and 1,200 feet for Rotterdam, the world's busiest port (averaging 100 ships per day).

Traffic into and out on Valdez Harbor will be shore-controlled (controlled, not

monitored) and assigned to separated oneway traffic lanes. Professor Rice says, "Crammed harbor conditions in the Valdez Arm of Prince William Sound and the task of coordinating frequent tanker movements through the 50 miles of straits and islands to the south make this alternative problematical..." Problematical indeed! Is the professor to have us believe that in the present state of the maritime art, and in just having read his endorsement of vastly inferior ports west of Valdez, we are going to have difficulty getting through the six-mi.-wide deepwater Hinchinbrook Channel at the entrance to Prince William Sound?

The choice of Valdez, if one accepts these criteria, is understandable. We also agree that tides are minimal and water deep. The "crammed" conditions referred to are rocks at the narrow throat of the harbor, through which it will be difficult to manage supertankers under conditions of wind or fog. We understand that the Coast Guard has registered its objectionsand that plans to use 250,000-ton supertankers have been dropped in favor of tankers of about 100,000 tons. It is agreed that the word "crammed" is misleading; "constrained" would have been a better

12. The earthquake hazard has been designed out of the trans-Alaska Pipeline by better safety factors than ever before employed in a man-made structure. The

safety factors are considerably higher than those required by building codes even for skyscrapers in Los Angeles and San Francisco, despite the fact that the potential damage from the structural failure of one of those buildings dwarfs that which could conceivably result from any failure of the Alaska pipeline. Further, the Alaska pipeline route has been carefully selected to minimize exposure to avalanches, and this happens to be a much simpler job than protecting steep railroad cuts from such phenomena.

We feel that the avalanche and rockslide hazard is probably greater than the hazard of a break due to direct earthquake damage. Both, however, are still significant in this belt. The Russians are having continuing problems with some of their new Siberian pipelines in more favorable ter-

rain.

13. In showing concern for "proper heat for the oil to pass through the pipeline," we assume that Professor Rice has also shown concern for methods of removing jelled crude oil from tank cars after the frigid 2.6-day winter journey to the U.S. Midwest. Of course the tank cars could be insulated and heated, but at a tidy cost. In the pipeline, friction and pump turbulence keep the oil at a comfortable flowing temperature.

This topic is covered in our basic report but could not be included in the abridgment for Technology Review. The 150° oil will drop to around 90° to 100° in three days of transit in insulated tank

cars.

14. Professor Rice says, "An essential part of either trans-Alaska oil pipeline system is a gas pipeline taking an entirely different route—eastward from Prudhoe Bay down the Mackenzie Valley to the U.S." Technically a gas pipeline is not essential inasmuch as the gas associated with the Prudhoe crude oil could be pumped back down into the oil/gas strata. However, given the present shortage of natural gas in the U.S., a gas delivery system is vital to the national interest and will be developed and become operational shortly after the Alaska pipeline goes into service. The most advanced gas project is one sponsored by a group of 25 oil, gas, and utility companies to construct a 48-in. gas line from Prudhoe through the Brooks Range thence south of the Arctic Wildlife Range to the Mackenzie Valley and on to the U.S. Midwest. Inasmuch as a cold gas line represents much simpler problems in the Arctic than a warm oil line, I am at a loss to understand Professor Rice's speculation that "the gas pipeline might be ruled environmentally infeasible."

A second investigation has been commenced (El Paso Natural Gas Co.) of the feasibility of a gas pipeline in the same Federal corridor as T.A.P.S. with a liquefaction plant at Cordova (near Valdez) for tanker shipment to the West Coast.

Most authorities quoted in Oil and Gas Journal believe the transport of gas should begin within 12 months of the opening of

the oil pipeline.

15. Inasmuch as Professor Rice provides very little data beyond the realm of handbook engineering but does allude to a report prepared by the Canadian Institute of Guided Ground Transportation, perhaps a few of C.I.G.G.T.'s statistics side by

side with those of an oil pipeline might be relevant:

a. The necessary 1,240 miles of rail right-of-way across the Arctic wilderness cannot be cleared and leveled to a grade not exceeding 0.5 per cent (C.I.G.G.T.'s grade vs. Rich's 1.0 per cent) at lower cost than the relatively minor grading required to permit the 789-mile Alaska pipeline to travel up and down slopes of up to 30 per cent. The Canadian report says that 395 to 505 million cubic yards of fill and track ballast will be required. By contrast, the pipeline and its accompanying road require one-tenth or less as much gravel or crushed rock.

b. Moving 2 million bbl./day of crude oil by rail at 50 to 60 m.p.h. along with several hundred thousand tons per day of deadheaded rolling stock results in much higher operating and energy costs than required for a pipeline—which moves nothing but oil at a safe 7 m.p.h.

c. The cost of support in the wilderness, and the environmental impact, of the 4,600 people required to operate and maintain the railroad is orders of magnitude greater than for the 100 to 150 people

required by the pipeline.

d. The rail study did not debit the rail system for the capital costs of making available extremely large volumes of diesel fuel in the Arctic. These costs are included in the T.A.P.S. proposal.

e. The numerous (several hundred) heavy-duty bridges required by the rail system are hundreds of times more expensive than the required two to four rela-

tively light-duty pipeline bridges.

f. The rail study forecasts that the track bed alone will occupy—in the Arctic—150 sq. mi. of land, with an additional 1,240 sq. mi. of clearing for drainage and support facilities. The total pipeline system will occupy 12 sq. mi. with a temporary (construction) impact on an additional 50 to 60 sq. mi. The relative impact on wilderness values and wildlife habitat is obvious

g. As previously mentioned, the rail route crosses many dozens of major drainage systems between Prudhoe Bay and the Mackenzie Valley. The proposed pipeline crosses only one (Yukon). What is the relative potential effect on marine life?

h. The rail study, based on statistical performance, predicts "eight major derailments per year." That spillage will accompany derailments goes without saying. Conversely, the pipeline is designed to make it unlikely that one major spill will

occur in the life of the pipeline.

i. In using 20 trains per day, each of 168 cars (and five locomotives), the rail system must make approximately 6,600 connections and an equal number of disconnections in loading and unloading tank cars. The potential for oil spillage exists in each "connect" and "disconnect"; and hydrocarbon vapor emissions, for which the rail study has provided no collection system, will occur in each loading and unloading. The pipeline system has no "connects" and "disconnects" except for the two and one-half tankers per day at its southern terminus.

j. The railroad has 20 hurtling monsters per day in each direction. Noise pollution? Effect on wildlife?

k. In being 150 ft. wide at its base and

10 to 20 (or more) ft. above natural grade for appreciable mileage segments, the rail system constitutes a much greater barrier to animal migration than does the pipeline, more than half of which would be below ground, with no above-ground segment more than eight feet above grade and with frequent overpasses and underpasses for animals.

The latest figures from the C.I.G.G.T. studies appear realistic to us. Surprising as it seems, it will in fact take less horsepower to run the Arctic railway than the T.A.P.S.

The rest of these points are tradeoff factors—and are best expressed by the conclusions of those who have studied both points of view, namely:

The Mackenzie plan will tap two to three times the oil reserves at half the investment of the T.A.P.S. plan. Environmentalists are almost unanimously sup-

porting Mackenzie over T.A.P.S.

In winding this up I'd like to make two to three quick observations as to the presumed value of an Arctic railroad in delivering freight and people to the Arctic regions. The financial and other problems of the existing railroad from Anchorage to Fairbanks and of other rail systems serving lightly (negligibly is more accurate) populated areas have apparently escaped the attention of Professor Rice. Nor is Amtrak a howling success in even the most densely populated areas of the U.S. The hundreds of thousands of tons of equipment and material presently on the North Slope were taken there principally by sea by advanced planning to make use of the four to five weeks per summer open to sea traffic. The foreseeable needs for heavy transport to the U.S. Arctic can be met in similar fashion, with help also from the road which is part of the free-enterprise Alaska pipeline venture but becomes a state highway upon completion of pipeline construction.

In our original report 15 polar and subpolar rail lines were cited or studied. (There are no large diameter sub-polar crude oil lines in operation yet to cite.) Amtrak is a subsidized passenger carrier, not a taxpaying Class I railroad. The backhaul and defense value of a railway to Alaska cannot be overestimated.

Only a rudimentary knowledge of economic principles and free-enterprise responsibilities to shareholders is required to enable one to forecast with a high degree of certainty that a long-line Arctic railroad is not going to come to pass by any means short of a federal (U.S. and/or Canadian) project, and I would imagine the tax-payers might have a voice in that matter. For another thing, barring a disastrous overpopulation of the more temperate regions of the earth, Professor Rice's demographic projections for the Arctic and sub-Arctic regions are unlikely to come about. One need look no further than the difficulties the governments of Norway, Sweden, Finland, and the U.S.S.R. have had in persuading people to live in those latitudes to know that a population of 2 million or more in the Northwest Territory and Alaska is a long way down the road.

and Alaska is a long way down the road.

Contrary to the implications of this paragraph, the same latitudes in Scandinavia support several thousand miles of railroad and several million people, as our

study shows.

More Hospitals to Fill: **Abuses Grow**

If any institution intimately brings science and technology to the people, it is the hospital.

X-rays, heart surgery, plastic heart valves and electronic pacemakers, auto-mated monitoring, automated laboratories, molecular engineering of drugs in daily use—it is all there, all the modern sorcery, right down the highway a little ways from home in St. Mary's and Mount Sinais and Bigcity Generals and Blankville Community Hospitals by the thousands.

All the modern sorcery. But also today, a sorcerer's apprentice seems to be putting up these complex and expensive institu-

tions one after the other.

In short, we are building so many hospitals in almost every city that they are certain to give us poorer rather than better care at rates outrageously beyond even the high rates needed for late-20th-century lifesaving.

Consider the part of the country within a 35-mile radius of the nation's capital. This section—the District of Columbia and generous wedges of Virginia and Mary-land—is also within a 35-mile reach of the Department of Health, Education and Welfare, the supposed center of the nation's health planning and the spearhead of attack on runaway health costs.

Late last year the metropolitan editor of the Washington Post asked me to look into a hospital-building controversy. It seemed that George Washington Medical Center, one of the capital's three university hospitals, was turning over greater authority to a core of full-time academicians, and the reform or its manner had angered some 50 of the area's finest specialists, who had decided to start their

One week in NASSAU See insert at page 72

own 200-bed hospital a few miles away.

From a public standpoint, there were only two troubles. One, though the dissident doctors said that "not a cent of public money" would be required for their \$16-million-or-so institution because they would get the money from private lenders, in fact the public would pay. Though private hospital builders almost universally deny it, the public always does.

Ninety cents of every hospital dollar, including the money to pay off lenders, comes from Blue Cross and other health insurors and from federal and local governments paying for Medicare, Medicaid, and other public patients. The other 10 cents is cash from current patients. In other words, it is you and I who always pay the building bill in the form of health insurance premiums, taxes, or

Two, this new hospital would be ringed by existing hospitals, most of which were already experiencing a shortage of patients. Virtually every health authority in the area believed the new hospital was unneeded.

This seemed bad enough. But inquiry soon disclosed that this proposed hos-pital's situation was not unique, and new hospitals or additions had been springing up or were about to do so all over the metropolitan area.

Empty Beds, Empty Pockets

Just how much such building? Well, no one had planned it all, and no one really knew. It took a major investigation and virtually a community-by-community inquiry to learn that all hospital or related health facility construction completed since January 1, 1972, or now under way or on drawing boards would, if all completed, add 4,684 beds or some 40 per cent to this area's hospital capacity years earlier than anyone believed all these beds would be needed.

The cost at the least possible estimate would be an astonishing \$505.8 million. Given these facts and figures and population projections, area Blue Cross and other analysts estimated that about half of the new hospital construction was not needed, and the cost of buying all the unnecessary bricks, mortar and electronic monitors would be just the beginning.

Hospital building sprees cause several

One is beds that too often stand empty, at a cost estimated to run from 15 to

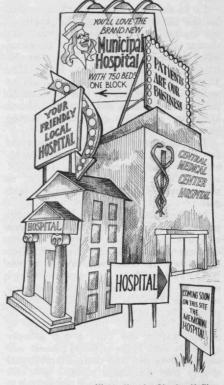


Illustration by Charles Hefling

"...excess [hospital beds] leads to unnecessary hospital use which leads to unnecessary surgery and other abuses."

66 per cent of the cost of maintaining full beds. One hospital bed in five is already empty in the Washington area, and a third of all pediatric and obstetric beds are usually empty. Bed occupancy levels have been dropping and seem certain to drop further as new beds are added to the pool.

Hospital occupancy nationally was at last annual tally 74.9 per cent, down from 78.4 per cent four years before. This means that a quarter of the country's 1.5 million hospital beds are vacant at the average moment. In recent months the national occupancy figure has been running ahead of last year's by a point or two; in part, this may be because many

hospitals with the lowest occupancies have closed off some sections, removing them from the statistics. This year one major District of Columbia hospital and two in Northern Virginia, just across the Potomac, have closed off some beds at the same time or shortly after adding others by new construction.

Over-building also means fantastically expensive duplication and waste of complex facilities. An intensive and coronary care unit, a must today in any hospital worthy of the name, can easily cost \$500,-000; a rather simple X-ray department, an-

other \$500,000.

One price for these forms of waste is paid in higher health insurance premiums and taxes. Another comes in high hospital charges—an average daily charge now approaching \$117 a day. In the Washington area as of last Dec. 31, the figure was \$137; a larger figure is typical of major cities. In 1972 daily hospital costs climbed 11.5 per cent, although—a touch of good news—per-visit charges increased only 3.6 per cent, probably because of shorter stays.

Deteriorating Care

The cost measured in dollars is only the most obvious price. There is another: worse care. It is caused by spreading scarce personnel thin rather than concentrating them, and by a subtle relaxa-tion of medical standards to try to keep all the beds filled. A study by a committee of the Institute of Medicine of the National Academy of Sciences led to a sharp warning early this year on this point. It said excess bed supply leads to unnecessary hospital use which leads to unnecessary surgery and other abuses.

aggressive insurance Pennsylvania's commissioner Herbert S. Denenberg has said much the same thing in blunter language: "Skyrocketing hospital costs, unnecessary operations, unnecessary hospitalization, unnecessary facilities, fee-gouging and sub-standard care" go together, while in the U.S. today, "there are limited resources and infinite needs. We cannot even come close to meeting every real need, so when we waste resources, we are depriving someone of medical care that may save life and prevent disability. When we waste resources, we waste life and health."

We also make it ever harder for Congress to write a national health insurance bill that can come even close to meeting most of modern medicine's costs. The

United States, the only advanced nation without a thoroughgoing national health insurance plan, may also be the only country that has priced itself out of the national health insurance market.

What next?

In the most advanced cities, medically speaking-with Washington, nately, not yet among them-there is a

growing trend in four directions:

-"Regionalization," or establishing area centers for important but costly services like obstetrics. Not every hospital needs an OB or pediatric ward in a day of falling birth rates; fewer, better staffed ones can keep more children alive. Under new west-ern Pennsylvania and Philadelphia Blue Cross contracts, hospitals have agreed to a re-survey at least every five years to identify and phase out unneeded services.

Sharing rather than over-duplication of personnel and facilities ranging from laundries to open-heart units. Eleven Boston hospitals and medical schools have formed a joint corporation to pool land, medical services, purchasing, maintenance, and

laboratories.

-Outright hospital consolidations. In Minneapolis, a wave of mergers or at least strong sharing agreements has touched almost every hospital, converting a plethora of overly small ones into stronger group-

-Establishment of "satellite" or "multidivisional" hospitals, usually with a central institution as the apex for a coordinated system. Good Samaritan Hospital in downtown Phoenix has formed a confederation of nine Arizona hospitals. The Lutheran Hospital Society of Southern California has similarly tied together several. The number of such groupings has grown from 20 to at least 60 in the past two years.

But none of this is happening fast

enough.

In Britain there is no hospital overbuilding. Virtually all the hospitals in 1948 became government hospitals, part of the National Health Service. And the people are very healthy.

Is this the answer for our hospitals too? Is it what we should want as potential

It is something to think about, but to me the answer is "no." I will try to explore the alternatives in a future column.

Victor Cohn reports on major science-oriented affairs for The Washington Post.

Bill Campbell came to Northfield Mount Hermon and taught remedial reading at a local school.

Bill wanted to go to prep school but he didn't want to be a "preppie." He liked what his friends told him about Northfield Mount Hermon and a visit confirmed what he'd heard.

Sports and "involvement" are important to Bill Campbell. In his senior year he was co-captain of soccer, hockey and lacrosse, and was elected All-American for New England in soccer.

In his last term, he chose an apprenticeship to help a local high school student with a reading difficulty. Bill's comment: "I'm going to

get him through."

When he leaves his home in North Carolina to go to Brown next year, Bill may pursue his interests in teaching. Whatever he does, he'll beat the average. He wasn't an average student here. But then again, we don't think anybody is average.



Director of Admissions Northfield Mount Hermon School E. Northfield, Mass. 01360

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Ecology: Hard Push on a "Soft" Science

Four years ago, the passage of the National Environmental Policy Act (N.E.P.A.) promised to inaugurate an era of national concern for the environment. The Act "recognized that each person should enjoy a healthful environment" and grandiloquently proclaimed a national policy ". . . to create and maintain conditions under which man and nature can exist in productive harmony."

Depending on the expectations aroused in the individual reader by these words of 1969, N.E.P.A. might now be regarded either as a qualified success or as an unqualified failure. The courts have been re-luctant to interpret its extremely vague substantive provisions, and most litigation under the Act has been concerned with enforcing its procedural requirements, in particular the preparation and issuance of environmental impact statements.

If the success of N.E.P.A. is judged by the extent to which it has enabled citizens to achieve a better environment through better federal decision-making, its history to date is disappointing. Some federal agencies are still failing to take its requirements seriously and, in certain cases, their compliance has consisted of super-ficial analyses of environmental impacts prepared after their projects were underway. On the other hand, N.E.P.A. has enabled public interest groups to force the more intransigent agencies at least to list and describe potential environmental impacts. This unusual experience has certainly had an educative effect on the agencies' personnel, and in some cases this appears to be leading to changes in underlying attitudes and policies.

Another interesting consequence of N.E.P.A. has been the creation of a new professional discipline: the assessment of environmental impact. The gradual enforcement of the Act's requirement for the writing of environmental impact statements has led to the diversion of hundreds of scientists, engineers, and economists to the preparation of public statements predicting the environmental consequences of their agencies' projects. As successive court decisions have broadened the coverage required by the statements, these new pro-fessionals have gradually extended their assessments to include secondary and farreaching impacts on the entire human en-

Until the new professionals mastered their discipline, the resulting controversies often generated more heat than light. "Ad-



"Some of our most ravaged and degraded landscapes (the English countryside is a prime example) are among the most aesthetically appreciated."

versary science" is not new, but it has been institutionalized and made intellectually respectable by N.E.P.A., while its arena has shifted from the evangelical book and provocative pamphlet to the somewhat more orderly atmosphere of the public hearing and courtroom. Here, under the cold light of cross-examination, many "en-vironmental scientists" have found the limits of their knowledge and expertise exposed with embarrassing clarity.

All too often, ecologists who make pre-cise predictions have found the bases for their predictions abruptly challenged, or heard other ecologists make diametrically opposite predictions from the same base of data. These controversies have made clear that ecology is still a "soft science," in which interpretations of past observations are often subjective, theories are still rudimentary, and predictions of future events are very uncertain. Practitioners of the "hard sciences" are apt to be impatient with the vague generalizations and subjective arguments of ecologists, but there are in fact several very sound reasons for their difficulties.

Ecological Complexities

In the first place, natural ecosystems are extraordinarily diverse. Roughly two million species of plants and animals have already been described on the earth, and some experts believe many more remain undiscovered. Only a tiny fraction of the known species have been studied in detail,

and these display an extraordinary variety of lifestyles, function, and sensitivity to disturbance. Even a highly simplified ecosystem such as a cornfield or a lawn may contain hundreds or thousands of species, and some critical ecological functions are performed by small invertebrates or microorganisms that are inconspicuous and poorly known. The ecologist's response to this difficulty is to study functional groups of species, or to select a few conspicuous species as representative of the larger system. However, these selections and groupings are often intuitive, and it is difficult to be sure that they represent adequately the real world.

The second reason is that the "noise" level in natural systems is very high. The physical environment varies continuously as the climate and weather fluctuate; species fluctuate in numbers, often violently; mobile animals move from place to place. Some of these changes are predictable, but most are not. Even in the absence of human disturbance, it is difficult to interpret observed changes in biological populations and to relate them convincingly to their causes. Accordingly it is very difficult to exclude the possibility of a natural cause, even when an adverse effect on a wild population can be associated very closely with a technological insult.

Compounding this difficulty is the multiplicity of technological stresses imposed by man. Disturbance, physical stresses, and chemical pollution are often closely associated in time and space, so that it is usually very difficult to trace observed adverse effects, however large, to their specific causes. However, it may be essential to do so if corrective measures are to be taken promptly.

Another major source of controversy is the wide variation between ecologists in their demands for proof. At one extreme, some environmental scientists appear to assume that technologies should be deemed innocent until proven guilty. Others, taking an obverse stand, point to case-histories of bizarre and unforeseen environmental disasters, and they reject almost all demonstrations of safety as incomplete. These differences in attitude, often unstated, frequently result in scientists for opposing sides asserting-with equal honesty-that there is no good evidence for safety or for hazard of a technology. Those who portray the issues as all black or all white contribute less to the decision-making process than those who offer reasoned estimates of probabilities and degrees of damage.

Environmental Values

Even if we could agree precisely on the probability of damage stemming from a technological project, there would remain a major problem: what significance to ascribe in cost-benefit analysis. In a few cases, where the impact is on a well-defined group of species of economic value, such as a fishery, its magnitude can be assessed reasonably well in economic terms. More often, however, the potential impact is a widespread and ill-defined degradation, impoverishment of species, loss of variety, or impairment of function of an ecosystem. The economic significance of these changes—the extent to which society would be prepared to forego economic benefits to avoid them—depends very strongly on the values ascribed by society to environmental quality.

Ecologists and conservationists have long struggled with the problem of identifying and measuring natural values. The old concept of the balance of nature initially guided these attempts: the further a system is perturbed from equilibrium, the greater the "damage." However, as we have come to appreciate that nature's equilibria are transient rather than static, it has become harder to label all changes as adverse. Present-day attempts to identify natural values focus on structural and functional properties of ecosystems such as productivity, diversity, and stability. But in

any case it is clear that these are not society's values. Some of our most ravaged and degraded landscapes are among the most aesthetically appreciated (the English countryside is a prime example). Society clearly places a higher value on some plants and animals than others. Clean beaches and stark mountains are much more generally valued than more biologically interesting areas such as salt marshes and forest clearings. This fundamental problem of values will recur frequently in this series of articles, for it underlies all rational attempts to assess environmental impacts.

In the past, environmental damage has usually been ignored in cost-benefit analyses, primarily because of the difficulty of identification and quantitative estimation.

However, there is an increasing trend to give environmental factors at least token consideration in evaluating projects such as highways, airports, and dams, even if the decision-makers have to balance intangible against tangible values. The significance of N.E.P.A. is that it has institutionalized this trend as federal policy, and has introduced environmental impact assessments—however falteringly—into official decision-making.

Ian C. T. Nisbet, who holds a Ph.D. in physics from Cambridge University (1958), is Associate Director of the Scientific Staff of the Massachusetts Audubon Society. He currently is working on population biology and chemical pollution.

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Status Comes to Occult Science

According to the way you look at things, J. B. Rhine may be a latter day Copernicus, a man of extraordinary naivete, or one of the more daring charlatans to have invaded the ranks of science. Dr. Rhine is the Duke University psychologist who un-dertook a long series of card-guessing experiments throughout the 1930s and 1940s in the effort to prove or disprove the reality of clairvoyance-the ability to receive information at a distance from inanimate objects. When, after literally millions of card guesses, a number of Dr. Rhine's subjects showed card perception strikingly beyond the laws of chance, he and a small coterie of his colleagues concluded that clairvoyance and other parapsychological phenomena were for real. The few members of the scientific community who bothered to take any notice of Rhine's experiments dismissed them on the grounds of poor methodology, unreliable statistics, or fraud on the part of the subjects or the experimenters.

Now, all is changed. For Dr. Rhine, now retired from Duke but continuing his experiments at the nearby Foundation for the Study of the Nature of Man, the isolation is over. His once lonely furrow is being plowed by an increasing number of physicists, chemists, psychologists, and other scientists, who have been attracted by the upsurge of public interest in parapsychology, by research grants, and by sheer scientific curiosity, and who give it the appearance of scientific respectability that its more vocal proponents have long sought. The American Parapsychological Society has been elected to membership of the American Association for the Advancement of Science. The National Institute of Mental Health has made at least two major research grants for studies of paranormal phenomena. And some major universities and colleges have introduced courses on the paranormal into their cur-

The nature of the new scientific parapsychology varies from the sublime to the ridiculous. At Stanford Research, physicists Harold Putoff and Russell Targ are studying the psychic abilities claimed by Israeli stage magician Uri Geller. In one dramatic presentation of their work in a physics colloquium at Columbia University earlier this year, Putoff and Targ introduced a film that showed Mr. Geller correctly naming the upper face of dice he could not see, choosing the single container out of ten he had not previously seen that was filled

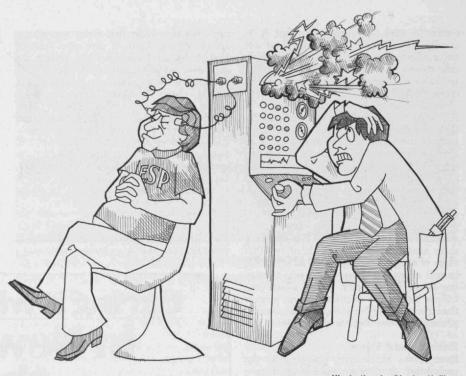


Illustration by Charles Hefling

"... mechanization of studies... is the only type of experimentation that will give studies of the paranormal . . . respectability..."

with water, and influencing, apparently by thought alone, the needle of a laboratory balance. What is remarkable about these studies is the fact that they were done under strict scientific scrutiny, in double blind fashion, and in the view of a number of film cameras.

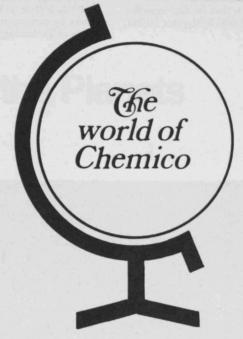
In another experiment, at Rosary Hill College in Buffalo, N.Y., biochemist Sister Justa Smith is analyzing enzyme solutions that received the traditional healing treatment—laying on of hands—from Hun-garian faith healer Oskar Estebany. The effect of the procedure is apparently to speed up the enzyme reactions. At Duke University, Dr. Helmut Schmidt has mechanized the old clairvoyance and precognition experiments; instead of using cards, he asks his subjects to guess which of four colored lights will light up next. The lights are controlled by radioactive decay-perhaps the most unpredictable phenomenon known to man. And at the University of California at Los Angeles, investigators led

by Thelma Moss are studying fingerprint images known as Kirlian photographs, which in the view of some parapsychologists prove the existence of a psychic

Aura of Respectability

One of the main reasons for the current interest in parapsychology has been the enchantment of young people with alien cultures and all they imply in terms of gurus, meditation, and altered states of consciousness, and there is undoubtedly a get-rich-quick aspect to much of the parapsychology teaching now offered os-tensibly in the cause of the advancement of science. Courses on improving one's E.S.P. and on mini-histories of the supernatural hardly fulfill what one would like to regard as the stiff intellectual requirements of university curricula. And much of the current research in parapsychology seems to be conducted with the objectivity of, say, a Jean Dixon.

ENGINEERS



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A case in point is Kirlian photography. A Kirlian photograph is made by passing an electric spark through a finger held against a photographic film. On develop-ment of the film, the result is a colored aura around the image of the finger that, according to the mood of the subject can be large or small, bright or dull, and any one of a number of hues. But the idea that this is the long-sought and previously invisible psychic aura collapses rapidly to the hard-nosed assault of physical science. As William Tiller of Stanford University's Department of Materials Science explains, the differences between Kirlian photographs of individuals can be accounted for on the basis of sweat and other chemicals in the subjects' skin, electrical energy in the epidermis, the topology of the fingerprints, and physical buckling of the photographic film. In this light, Kirlian photography is hardly more demonstrative of a psychic force than psychiatry is of faith healing.

Yet there are some imponderable dimensions to Kirlian photography. Claimants of psychic powers such as Mr. Geller appear able to adjust the shapes, sizes, and colors of their Kirlian photographs to order, and the Kirlian photographs of psychic healers uniformly change from large, bright, and red to small, dull, and blue during the course of healing sessions. Here, there would appear to be subjects for fruitful

scientific investigation.

This point touches on another of prime importance to any truly convincing effort to discover what makes the paranormal tick—the question of repeatability. Many paranormal experiences are essentially subjective, and ipso facto not amenable to investigation by the traditional methods of physical science. Arthur Koestler, one of the more notable authorities now calling for an in-depth look at parapsychology, advocates an entirely new approach to this subject, based on the premise that repeatability is impossible.

However, it seems possible that me-chanization of studies in the paranormal, such as that pioneered by Helmut Schmidt, will give different investigators the chance to study the same phenomena. And in the eyes of the scientific community, it is only this type of experimentation that will give study of the paranormal the respectability towards which it is now striving.

Formerly Managing Editor of Technology Review, Peter Gwynne is now Associate Editor of Newsweek.

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Hubble's variable nebula (NGC 2261; right ascension 6 h 36 m, declination + 8° 46') in the constellation Monoceros (the Unicorn), near the celestial equator between the constellations Orion and Canus Major. The density of our galaxy, the Milky Way, appears from Earth to be lowest in Monoceros, and highest in the opposite direction, toward Sagittarius and the center of the galaxy. Hubble's variable nebula is thus farther from the center of the Milky Way than we are—6,500 light years farther, by one calculation.

The nebula's luminosity is not its own, but rather that of R-Monocerotis, an associated "variable star," whose brightening and dimming alters in a few days the outline and luminosity of the nebula as seen from Earth. NGC 2261 might be a solar nebula—a gas cloud beginning to accrete into a solar system. The photograph was the first official photograph taken through the 200-inch Hale Telescope on Mount Palomar; it is reproduced here by permission of the Hale Observatories, California Institute of Technology.



John S. Lewis
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Could a gas containing the chemical elements in the sun have condensed into the planets and satellites? How well do models of this process fit our solar system?

The Origin of the Planets and Satellites

One way to estimate the age of the universe is by measuring the velocities at which galaxies are moving away from one another. We find that galaxies are moving away from us with velocities directly proportional to their distances from us, so the ratio of velocity to distance is a constant, has dimensions of time, and a value of approximately 15 billion years. This suggests a first-order model for the universe: that it is expanding and has been expanding for about 15 billion years, and that no material objects in it can be older than that figure.

In seeking a time scale of the universe's history, we can make many types of dating measurements. Rhenium 187, for example, decays with an 11-billion-year halflife to osmium 187. We have some idea of the initial abundances of those isotopes from theoretical models of element formation inside stars. Thus we can measure the current ratio of 187Rh to 187Os and estimate how much time has elapsed since those elements were formed. The same can be done for the decay of rubidium 87 to strontium 87, although with less facility: while rhenium and osmium are chemically similar, rubidium and strontium could have been separated during melting processes. Both of these dating techniques applied to meteorites yield ages since the formation of the chemical elements of about 11 billion years, with an uncertainty of one to three billion years, depending upon which technique and which meteorite is considered.

Another figure of great interest for meteorites is how long they have existed as solid, cold bodies-how long, that is, since they were last heated or since they last underwent any kind of geochemical fractionation. This can be deduced by measuring the abundances of highly volatile radioactive decay products that are trapped inside them. If a meteorite is reheated or partially melted, it will lose by diffusion the rare gases produced by radioactive decay that have accumulated in it. This will, so to speak, set the clock back to zero, and the meteorite will have to start accumulating those gases all over again. The gases helium 4 (produced by the decay chains of uranium and thorium) and argon 40 (produced by the decay of the radionuclide potassium 40) are both abundant in meteorites. The most primitive meteorites of all, the ones that show least petrological evidence of reheating, have helium-retention and argon-retention ages of about 4.6 billion years. This seems to date the episode when material in our solar system first developed a recognizable structure, identifiable with the present solar system rather than with interstellar matter of unknown genealogy.

The dates of solar system bodies other than meteorites are harder to come by. Radioactive dating of samples from Earth is not quite satisfactory because the Earth has been geologically active since its formation; virtually every sample has been recycled several times during the history of the planet. Indeed, the oldest unaltered samples that one can find are only about 3.7 billion years old. Thus for the period from 4.6 to 3.7 billion years ago, we must remain dependent upon meteorites for evidence.

There is one other useful dating technique. Iodine 129 has a rather short half-life. Its decay product, xenon 129, is a gas which is not retained by matter being cooled down from high temperatures, because the solubility of xenon in silicate minerals is very small. In principle, then, any 129Xe now found in meteorites is due to their retention of 129I when they solidified. Measuring the 129Xe content of different meteorites and different mineral grains in meteorites suggests that about 150 to 200 million years elapsed between the last large-scale production of chemical elements and the formation of the meteorites as solid bodies 4.6 billion years ago. Therefore formation of the elements must have spanned several billion years. There was large scale element synthesis about 11 billion years ago, and there has been element production until at least as recently as 4.8 billion years ago.

This, then, is the approximate time scale of events in our galaxy: A few billion years passed before the first large-scale formation of the heavy chemical elements, a few billion more years passed before the formation of our solar system, and a few billion more years have passed since then.

Ultimately, in order to understand the origin of the solar system, we must face the questions of the origin of the chemical elements and the origin of the universe as well. But more immediately, many observational features of the planets, satellites, asteroids, and meteorites that compose the solar system are sufficiently secure so that we might profitably expend some effort trying to explain them. Let us begin by assembling the evidence.

Observational Evidence

There are approximately 2,000 meteorites available in laboratories on Earth for study. A relatively small number of them belong to exotic compositional classes, and no one can agree with anyone else on how they were made. Fortunately, most meteorites are members of a handful of different major classes, and there are some

strong boundary conditions on the formation of the major classes of meteorites which are of use to us.

Most meteorites are dominantly stony, of silicate composition. Most of the stones-those called chondritescontain little glassy beads of material, spherical blobs of once-molten silicates which in many cases failed to recrystallize over the entire age of the solar system. These little blobs are called "chondrules" after a Greek word which means "droplets." Almost without exception, chondritic meteorites have ages of 4.6 billion years, no matter how age is determined. Thus chondrites are

often termed "primitive material."

Some aspects of chondritic meteorites divide them into various compositional classes. First of all, the metallic iron abundance varies from one class to another. The amount of oxidized iron, which is principally found as ferrous iron in the silicate phases, also varies. In addition, the volatile content of the meteorites varies. From all this, we could infer that the formation temperatures for the different chondritic meteorite classes must cover a range from perhaps a little over 300 degrees Kelvin (which is about room temperature) up to about 500-600°K. for the most abundant types of meteorites.

We have another source of information bearing on the origin of the solar system: we have our extensive geochemical and geophysical observations on the Earth. We find from studying remnant magnetism in rocks that, as far back as 3.5 billion years ago, sedimentary rocks were being deposited in a magnetic field comparable in strength to the present magnetic field of the Earth. This means that, if we understand at all where the Earth's magnetic field comes from, we would have to conclude that the Earth's core was in place and func-

tioning normally 3.5 billion years ago.

This is not a trivial matter to arrange. If one takes a mixture of iron and major silicates in the proportions in which they are found in meteorites, assembles them cold into an object the size of the Earth, and then allows that object to heat up by the decay of the long-lived radioactive elements uranium, thorium, and potassium, melting would begin after about 1.5 billion years. Dense molten iron would then sink and lighter silicates would rise, and this would liberate gravitational potential energy as the dense material settled down to form a core. The temperature would be increased by this differentiation process, which would mean more melting, meaning in turn more separation of phases, and so on. In the language of a chemist, it is an auto-catalytic process. In

short, the Earth would differentiate catastrophically some 1.5 billion years after its formation—that is, 3.1 billion years ago.

There is something wrong. Either the chemical model that is used to decide when the Earth should melt is wrong, or the Earth must have accumulated already hot. Otherwise, it would not have had a core and a

magnetic field 3.5 billion years ago.

We do know quite a bit about the composition of the Earth, but in a very restricted sense: We know a great deal about the composition of the Earth's crust, which is the topmost one per cent of the planet. But below that is the mantle, making up over 67 per cent. It is fairly difficult to tell what constitutes a good sample of the Earth's mantle. Anybody's favorite, taken from inclusions in volcanic rocks, is very likely to be bothersome to someone else's ideas. If we could drill a hole into the mantle, take an in situ sample, and transfer it back to our laboratories, the amount of debate would be greatly lessened.

Then there is the Earth's core, the inner 31 per cent of the Earth's mass. Virtually all we know about the core comes from seismic data. We know how density increases with depth in the Earth, and we find large density discontinuities that clearly show either physical phase transitions of minerals, or compositional discontinuities. Laboratory studies on the properties of minerals can in principle determine the mean atomic weight of the Earth as a function of depth. However, it is almost always possible to make up dozens of different samples which differ radically in chemistry but have the same mean atomic weight. Nevertheless, the seismic data indicates a density slightly higher than that of iron for the inner core. And this can very plausibly be explained by claiming that the inner core of the Earth is a meteoritic sort of alloy of nickel and iron with a slightly higher nickel content than meteoritic nickeliron usually has, but within the range found in mete-

The outer core is liquid, not solid. It appears to have a substantially lower mean atomic weight, definitely less than that of pure iron. This requires an admixture of some light chemical element or elements. The two most popular candidates for this role are silicon and sulfur.

We have other classes of observational data on the Earth. We can, for example, measure the heat flow passing through the crust of the planet due to release of heat from the interior. This heat loss is about one microcalorie per square centimeter per second, about

one part in 100,000 of the amount of solar energy hitting the surface of the Earth. Remarkably enough, the steady-state loss of heat from an Earth that has the same elemental composition as the ordinary chondrites (the most abundant class of stony meteorites) is, to two or three significant figures, the same heat flow as has been observed for the Earth. This is generally taken to be a coincidence. But is it? The question is whether, from our compositional knowledge of the Earth, we can account for as much potassium, uranium, and thorium as there ought to be in a chondritic-composition body the size of the Earth. It is fairly clear that the Earth has just about the right amount of uranium and thorium to be chondritic, but it appears to be deficient in potassium by perhaps a factor of four (based on the assumption that all the potassium on Earth is in the Earth's crust).

We have indirect evidence about the thermal state of the interior of the Earth from continental drift, which requires, according to most modern theories, convection in the Earth's mantle (see "The Convective Earth," by M. Nafi Toksöz, on pages 24-31 of Technology Review for December, 1972). The mantle does contain what are called hot spots. It appears, for example, that continental drift is dragging the ocean floor of the Pacific over a hot spot located in the mantle, and that this hot spot is causing melting and a chain of volcanos. Geologists have dated the ages of the rocks in volcanos that stretch out across the floor of the Pacific and have found that the ages indeed form a linear sequence. At the young end of the chain, the Hawaiian Islands, volcanos are at this moment forming rocks with gas retention ages of zero. What is the cause of these hot spots? Presumably it is heat being transported upward by convection in the upper mantle. The ultimate origin of that heat is a matter of great interest.

We have a related problem in the maintenance of the Earth's magnetic field. It requires the dissipation of a few times 1016 ergs per second to maintain the field, which would otherwise leak away and leave the Earth demagnetized within about 10,000 years. Presumably, the magnetic field is due to motions in the Earth's core. It would be most interesting to know what source of

energy drives those motions.

This is all to say that we have an enormous amount of information concerning the conditions of formation and the composition of the Earth, but it is exceedingly difficult to interpret this information by study of the Earth alone. However, any postulates we might make about the origins of the solar system's planets would have to produce Earth with the right conditions to satisfy our present observations. I think this is the spirit in which we should talk about the Earth: too much local data, and-since all we usually see of the Earth is its crust—too inequitable a distribution of samples.

The other bodies in the solar system contribute some useful information. The densities of the planets and satellites reflect their bulk compositions. In addition, the abundance and composition of volatile matter on the planets can be deduced from spectroscopic studies

of planetary atmospheres.

We have observational evidence from outside our solar system which is not terribly conclusive, but still very suggestive. We see astronomical bodies which appear to be clouds of interstellar material in a state of collapse, leading up to the formation of planetary systems. We see the Orion Nebula, in which stars are constantly appearing. We see "T-Tauri stars"-very young stars, usually enmeshed in gas and dust clouds which are too bright for their color (or too red for their luminosity) relative to ordinary stable stars. They appear to be liberating energy not only from nuclear reactions but also from gravitational collapse. There is the famous infrared object, R-Monocerotis (see page 20). "Monoceros," which is the Latin word for "unicorn," is the name of a Southern constellation. Within it, R-Monocerotis appears to be a gas cloud comparable in size to the solar system, emitting a large amount of infrared radiation with a temperature of about 700°K.not a temperature that one would normally associate with a star. This probably indicates a rather short-lived transitional period in the evolution of an object from a collapsing interstellar gas cloud to a solar system. If we could make more detailed observations of R-Monocerotis with higher spatial and spectral resolution, we probably would learn a lot of interesting things. Unfortunately it is just technically infeasible.

Chemical Equilibrium in the Solar Nebula

As early as 1950, Harrison Brown, the pioneer of our subject, pointed out that there were three major compositional classes of bodies in the solar system: rocky, icy, and gaseous. The latter category was meant to suggest bodies similar in elemental composition to the sun. We still agree with his conclusions today, but I think we can now apply to the study of the solar system much more detailed knowledge about the chemical behavior of solar material. After all, planetary science has

been a very busy field since 1950.

It is possible for solid bodies of very different densities to condense out of a mixture of the chemical elements present in the sun. If such a mixture reaches chemical equilibrium at a temperature of a few hundred degrees Kelvin, the familiar rock-forming elements condense out as minerals to form a stony and metallic rock with a density of roughly four grams per cubic centimeter. At lower temperatures, among other things, hydrous minerals begin to form. They have much lower densities than unhydrated minerals; thus the density of condensed material decreases as the system is cooled. At low enough temperatures, water ice condenses. At still lower temperatures, ammonia and methane con-

It is apparent that chemical equilibrium calculations on material with the same elemental composition as the sun, made for a very wide range of temperatures and pressures, can give an idea of what the composition (and therefore the density) of condensed material would be as a function of the temperature and pressure at which it forms. It would be worthwhile to try to relate this to the solar system to see if there is any relation between theory and fact. To do this rigorously, we will have to know how pressure and temperature varied with distance from the sun at the time the

planets were forming.

Many scientists have created models of the solar nebula—an intimate mixture of gas and dust in the process of beginning to accrete into large lumps to form meteorites, satellites, and planets. It is fascinating to see how little these different models have in common with each other. There are only a few conditions that most people agree upon. They agree that this gas-dust medium decreased in density, in pressure, and in temperature outward from the sun. This is intuitively pleasant and not very profound, because extended to zero distance and to infinite distance, this condition predicts a dense, hot body which we can call the sun, and a cold vacuum which we can call interstellar space. The question is, of course, what do the temperature and pres-

sure profiles look like?

The most careful calculation that has yet been done on temperature and pressure profiles in a solar nebula has been made by Dr. A. G. W. Cameron of Harvard University; his calculation of pressure vs. temperature is shown in the illustration to the right. I'm convinced that it is the best effort available, and yet I regard it with considerable skepticism. I would claim that there is a large uncertainty in the gas pressure and the gas density in the solar nebula. I think there is considerably less uncertainty in the temperature, however, and I say this because one could get a temperature drop-off with distance that looked roughly like Cameron's by assuming that there was no solar nebula at all, but that particles in inter-planetary space reached thermal equilibrium with a protosun. Under that condition, though, the pressure profile would be completely different from Cameron's model, there being essentially no gas pressure if there was no solar nebula.

What gas densities are reasonable? I claim only that the most reasonable models are those which provide enough mass in the solar system to make the observed planets, but which do not provide such an embarrassingly large amount of mass that there is no conceivable way of getting rid of the excess. The upper limit is probably a few hundred times the present mass of the planets. Cameron's model happens to fit barely within these requirements. His model would be capable of producing dozens of planets like the Earth and

Venus in the inner solar system.

An Equilibrium Model for Planetary Formation

Now let us consider in detail how the chemical behavior of solar material depends on temperature and pressure. First we need to know the abundances of elements in the sun. The most abundant is hydrogen. We will assign it an atomic abundance of 10,000 atoms and normalize the atomic abundances of other elements to this figure. Helium has an atomic abundance of about 1,000. The third most abundant element is oxygen, with an abundance on our scale of about ten. The best

present estimate for the abundance of carbon is six. The nitrogen abundance is about two, neon (unimportant for us because it does not do anything interesting chemically) has an abundance of two, and silicon, magnesium and iron, one each. Sulfur is about 0.5, calcium, argon, and aluminum about 0.1 each, and all the other elements combined, about 0.1 All this means that in

principle the chemistry can be fairly simple.

The illustration to the right (Fig. 1) shows the major chemical events during cooling of solar material, as found from chemical equilibrium calculations. The temperature scale runs from zero to 2,200°K., the pressure scale (logarithmic in the illustration) from 10⁻⁷ to 10 atmospheres. The significance of the graph is best seen by imagining a cooling sequence, beginning at a temperature so high that everything is a gas. The materials which condense first are highly refractory oxide compounds containing calcium, titantium, vanadium, zir-conium, uranium, thorium, and other elements that form oxides with very low vapor pressures. (The top curve on the graph is for calcium titanate, CaTiO₃.) The next to condense is metallic iron. After that, magnesium silicate—the mineral enstatite—condenses. (The atomic abundances of magnesium and silicon are very nearly equal, so it is not surprising that the major product of their condensation is MgSiO3, rather than the other stable magnesium silicate, Mg2SiO4.) Above approximately 1200°K., sodium and potassium are present as gaseous atoms, but at about this temperature they enter into aluminous silicates.

At a much lower temperature, 675°K., sulfur-bearing gases in the nebula can react with the previously condensed metallic iron to make iron sulfide—the mineral troilite, FeS, which is present in all known meteorites. Next comes the formation of tremolite, a hydrous silicate which contains calcium. Thus water can be retained by the rocky material that solidifies from this temperature on down, but the amount of water is initially limited by the low abundance of calcium.

The next lower line in the illustration is the point at which all metallic iron has disappeared due to oxidation to make ferrous oxide, FeO, which is dissolved in silicate phases, mainly (Mg, Fe)SiO3 (pyroxene) and (Mg, Fe)₂SiO₄ (olivine), which are aptly described as ferromagnesian silicates. These two minerals account for most of the oxidized iron, most of the magnesium, and most of the silicon in meteorites. The amount of iron oxide in the silicates is .01 to .001 per cent at the temperature at which MgSiO₃ first condenses; it increases as the temperature falls, finally reaching about 50 per cent in olivine when the supply of metallic iron is exhausted. The number one-half is not surprising, because the abundances of iron, magnesium, and silicon are all about the same.

The next major chemical reaction is the formation of tale, a hydrous ferromagnesian mineral which does not contain any rare element as an essential ingredient. Thus it can be formed in very large quantities; in fact, the silicates olivine and pyroxene will be altered to hydrous minerals. This means that a large amount of water can be retained, not as free liquid water or as ice, but as water of hydration.

The last major chemical event shown in Fig. 1 is the condensation of water vapor as ice near 150°K.; then we enter the temperature range in which ices condense

(Fig. 2).

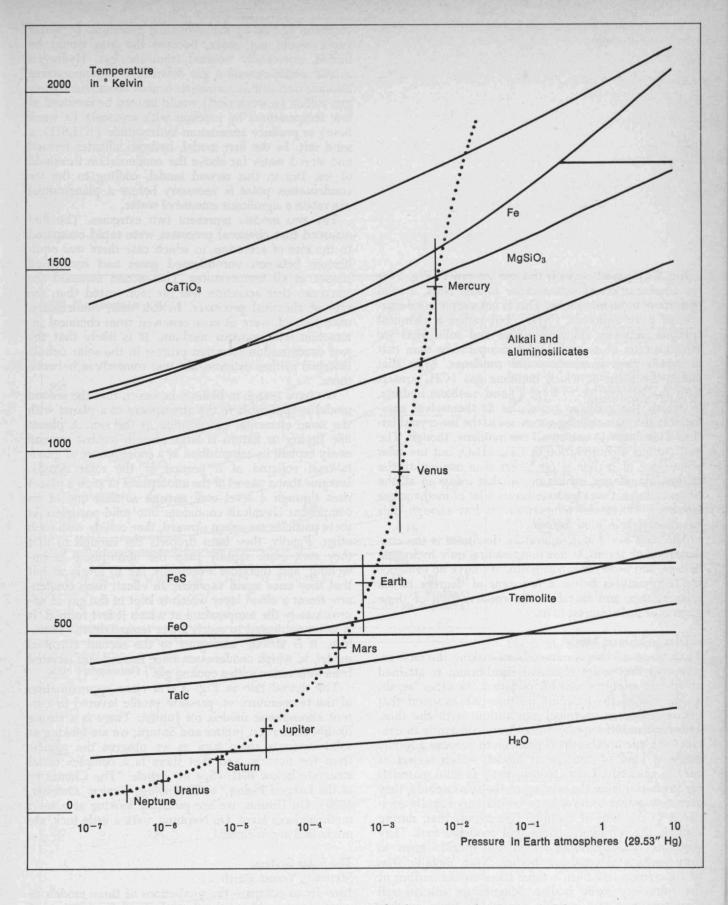


Fig. 1: Condensation thresholds of compounds in the cooling solar nebula-a gaseous mixture of chemical elements in the proportions found in our sun. Above the topmost curve on the chart, the entire mixture is gaseous, but at any point on that threshold curve, calcium titanate condenses out as solid particles. As the temperature of the nebula decreases further, additional materials condense, as shown by the other threshold curves.

The chart requires the assumption that accretion took place slowly compared to the nebula's rate of cooling, in which case chemical equilibrium was maintained between condensates and the cooling gas. The dotted line is Dr. A.G.W. Cameron's model of temperature vs. pressure in the solar nebula at the time the solar system formed; points on the line are the model's formation conditions for the planets.

Fig. 2's topmost curve is the one we saw in Fig. 1 for the condensation of water vapor to ice. Next, a solid hydrate of ammonia forms. This is not simple condensation of pure ammonia (NH₃), but rather a chemical reaction between ammonia vapor and solid H2O ice which occurs at a much higher temperature than that at which pure ammonia could condense. After that comes the point at which methane gas (CH₄) reacts with the leftover ice to form a solid methane hydrate, in which the methane molecules fit themselves comfortably into pre-existing vacancies in the ice-crystal lattice. This does not use up all the methane, though. The hydrate has a composition of CH₄·8H₂O, but the solar abundance of carbon is far larger than one-eighth the oxygen abundance, which means that using up all the ice to make methane hydrate leaves a lot of methane gas left over. When the temperature is low enough, this gas condenses as solid methane.

The next event as temperature decreases is the condensation of argon. At this temperature, only hydrogen, helium, and neon remain as gases. We have no evidence for temperatures below a few tens of degrees in the solar system, and therefore the condensation of these

gases is of little interest to us.

A Disequilibrium Model

Throughout all this, we have been making the tacit assumption that exact chemical equilibrium is attained at all temperatures and all pressures. In other words, as we cooled the gas-dust mixture, we assumed that gas remained in chemical equilibrium with the dust. This required that gas and dust were constantly in contact with one another. It is possible to propose a totally different kind of conceptual model, which is just as easy to calculate. Let us assume that, as solid materials are produced from the cooling of the solar nebula, they accrete together to form large bodies very rapidly compared to the rate of cooling. This means that, during cooling, the refractory oxides will condense first. They will form little particles which will quickly grow to form perhaps asteroid-size bodies. Next, metallic iron will condense and form a thick layer on the surface of the refractory oxide bodies. Magnesium silicate will then condense and quickly accrete to form another layer, and so on. The low-temperature end of this condensation sequence is shown at lower right (Fig. 3).

This second model gives a much simpler sequence of chemical reactions, and it engenders profound differences from the first. Here, the oxidation of iron and the corrosion of iron by sulfur-bearing gases and by water vapor would not occur, because the iron would be buried, chemically isolated from the gas. Hydrogen sulfide would remain a gas down to low temperatures because iron sulfide formation cannot occur; the hydrogen sulfide (a weak acid) would instead be removed at low temperatures by reaction with ammonia (a weak base) to produce ammonium hydrosulfide (NH4SH), a solid salt. In the first model, hydrous silicates formed and stored water far above the condensation threshold of ice. But in this second model, cooling to the ice condensation point is necessary before a planetesimal can retain a significant amount of water.

The two models represent two extremes. The first assumed that chemical processes were rapid compared to the rate of accretion, in which case there was equilibrium between uncondensed gases and condensed phases at all temperatures. The second assumed the converse: that accretion was far more rapid than the rate of chemical processes. In this case, condensates, once formed, were at once removed from chemical interaction with gaseous medium. It is likely that the real condensation-accretion process in the solar nebula matched neither extreme, but was somewhere between

them.

We have reason to believe, however, that the second model is applicable to the atmosphere of a planet with the same elemental composition as the sun. A planet like Jupiter or Saturn is large enough so that we can easily explain its composition as a consequence of gravitational collapse of a portion of the solar nebula. Imagine that a parcel of the atmosphere of such a planet rises through a level cool enough so that one of its component chemicals condenses into solid particles. As these particles are swept upward, they collide with each other. Finally, they form droplets big enough so that they sink more rapidly than the atmosphere is upwelling, and therefore eventually fall to levels so hot that they once again vaporize. In effect, each condensate forms a cloud layer which is kept in the gas at approximately the temperature at which it first formed. It is never subjected to much lower temperatures. Therefore, it is strictly analogous to the second chemical model, in which condensates, once formed, are isolated from interaction with a cooling gas.

The dotted line in Fig. 3 is a close approximation of the temperature vs. pressure profile favored in current atmospheric models for Jupiter. There is a strong likelihood that on Jupiter and Saturn, we are looking at solid-ammonia cloud tops as we observe the planets from the outside, and that there is a complex cloud structure below that. (See my article, "The Chemistry of the Largest Planet," in Technology Review, October, 1969). On Uranus, we are probably looking at a solid methane haze layer. On Neptune, with a little luck, we

might find argon clouds!

The Solar System: Mercury, Venus, Earth . . .

Now let us compare the predictions of these models to what is known about the densities and compositions of the solid bodies in the solar system.

Fig. 4 spans the inner solar system. The ordinate axis shows mean atomic weight (which can be converted to density); the abscissa shows formation temperature, which decreases to the right, so it can also be taken as

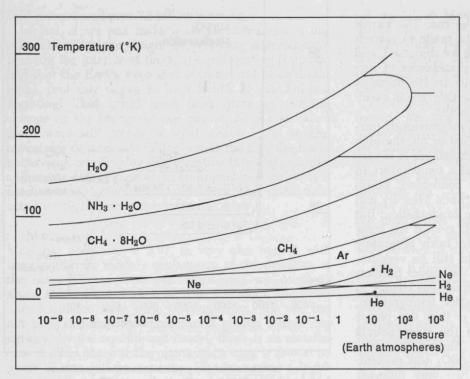


Fig. 2: The low-temperature end of a condensation sequence assuming, as in Fig. 1, that accretion proceeded slowly enough so that chemical equilibrium was attained at all temperatures. The topmost curve in this illustration is the bottom curve of Fig. 1: the condensation of water ice. Two points should be noted: "Pressure" in this illustration and in Figures 1 and 3 is taken to be the pressure of hydrogen and helium above hydrogen's condensation thres-hold. Though the actual pressure drops when hydrogen and helium condense, we retain the gaseous pressures even below those thresholds, since pressure figures are meant to be proportional to abundances. Secondly, the complications toward the right sides of these illustrations are due to phase transitions from solids to liquids, but these occur at pressures higher than are theorized for the solar nebula.

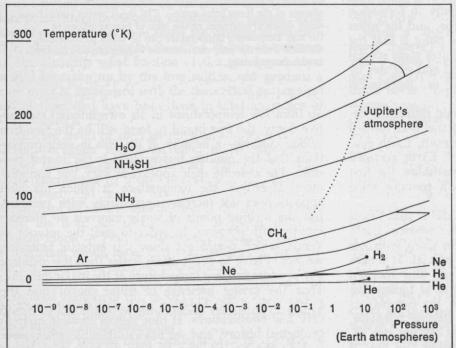


Fig. 3: The low-temperature end of a condensation sequence assuming that accretion was rapid compared to the rate of cooling of the solar nebula, so that condensates, once formed, were isolated from further reactions with the cooling gas. The lowest three curves—those for hydrogen, helium, and neonare unaltered, but the rest of the sequence differs from that of the equilibrium model. In this rapid-accretion sequence, for example, no significant amount of water can be retained by a planetesimal until the formation temperature is cold enough to freeze water. The dotted line approximates the temperature vs. pressure profile favored by current models of Jupiter's atmosphere.

showing increasing distance from the sun. The curves are chemical equilibrium calculations made in accordance with the first of the two models we discussed, and using three different ratios of the abundances of iron and silicon in the sun. The data points are the densities of Mercury, Venus, Earth, and Mars; they are in excel-

lent agreement with the theoretical results.

Now we have explanations for several previously puzzling features of the solar system. First of all, the high density of Mercury is very simply explained. It is very rich in iron because it was formed at a temperature so high that silicates were not totally condensed. Moreover, the density drops off madly between Mercury and Venus because of magnesium silicate condensation. But there is an uncertainty in the model: even if we knew the formation temperature of Mercury fairly accurately from other considerations, we would still be very uncertain about exactly what density the model predicts for that planet, because there is an enormous change in density over a small range of formation temperatures. Probably the most sensible guess is that the planet Mercury accreted near a point in the solar nebula which separated the region where silicates were not stable from the region in which MgSiO₃ was present. Mercury therefore accreted from two very different components which differed only slightly in formation temperature. One was almost pure iron, and the other contained both iron and silicates. The point is that the high density of Mercury no longer requires some special method of fractionating between metal and silicates by magnetic properties or stickiness or mechanical strength.

The calculations tell us that the main difference between Venus and Earth is that our planet was formed at slightly lower temperatures. As a result, Earth contains iron sulfide and Venus does not. Earth accreted on the edge of the region in which tremolite, the first hydrous silicate, was formed, so Earth contains some

water while Venus contains none.

A plausible deduction from this model is that Venus is essentially devoid of sulfur and water, whereas Earth was lucky enough to retain some water along with lots of sulfur. The presence of sulfur is crucial. It means that, even though potassium, uranium, and thorium should produce about the same amount of radioactive heat in Venus as they do in the Earth, the two planets could undergo completely different melting behavior, and very different thermal evolutions. If we put together a chondritic Earth including sulfur and heat it

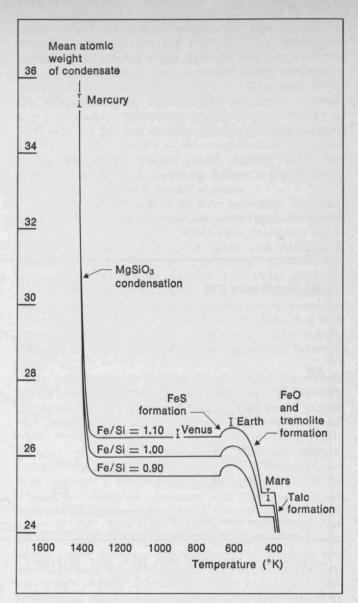


Fig. 4: A comparison of the predictions of the equilibrium model with the observed mean atomic weights of the four planets of the inner solar system. The three curves result from using different estimates of the ratio of iron to silicon in the sun. Decreasing temperature can be taken as increasing distance from the sun; mean atomic weight can be converted to planetary density.

up from low temperatures by its own internal radioactive decay, the first liquid to form will be the iron-iron sulfide eutectic-a mixture of the two in such proportions that the melting temperature is the lowest possible. The eutectic melt appears at very low temperatures. Moreover, the temperature at which the melt appears does not increase appreciably with pressure. But the melting points of single minerals do increase rapidly with pressure. In order to melt the interior of Venus, which would not show this eutectic behavior, we would have to get it much hotter than the ordinary low-pressure melting temperature of the major minerals. Thus the saving presence of sulfur means that the Earth, even if put together cold, will start to melt at very low temperatures. It thus begins to melt early in geological history, and we have no trouble whatsoever making the Earth's core in time to have a magnetic

field present well over 3.5 billion years ago.

In fact, if we just make a simple correction in our calculations for the weight of overlying material compressing the interior of the Earth and heating it up, we find that the Earth, even if it accreted out of cold material, probably began to melt before it was finished accreting! That could have been quite an exciting episode in the history of our planet. At a time when there were still pieces of solid material the size of mountains or asteroids falling out of the sky, the Earth underwent catastrophic differentation into core, mantle, and crust, with release of an enormous heat pulse. It is hard to imagine the extent of volcanic and earthquake activity which must have occurred.

... Mars ...

Mars has a density of 3.97, in very nice accord with the equilibrium model's explanation of the densities of the other terrestial planets. What can we conclude about Mars? First of all, iron oxide formation and tremolite formation have gone to completion, but tale has not been formed, since that would greatly reduce the density. By the equilibrium model, there is no metallic iron at all in Mars. If the planet has a core, it should be made of iron sulfide, not iron. The theoretical calculations that have been made on the rotational moment of inertia of Mars by several independent groups show that the core should have about the density of iron sulfide; also, if one estimates from the known abundances of the elements what fraction of the interior of Mars would be taken up by the iron sulfide, one predicts a core mass in agreement with the theoretical geophysical calculations that have been done in total ignorance of the chemistry.

Another result of such geophysical studies is that the density of Mars' mantle is found to be substantially higher than the density of Earth's mantle. This is usually interpreted to mean that Mars is not fully differentiated, and that it has metallic iron distributed throughout its mantle. But in view of the model's chemistry, the iron, not being present as metal, must be largely found as FeO in the mantle silicates. And differentiation would leave that oxidized iron in the mantle along with the silicates, thus explaining the mantle's high density. In fact, the density calculated for the mantle of Mars from this model falls quite nicely in the center of the range of geophysical estimates that have

been made. That is reassuring.

There are several other consequences of the chemi-

cal model of Mars. Complete retention of tremolite would give a several times higher percentage of water in Mars than we have on Earth, perhaps five or six times as much water per unit mass—enough to cover the surface of Mars with a layer of liquid water several kilometers deep if it were wholly released. Where is it?

Photographs of Mars do not reveal oceans and polar icecaps. We see instead polar caps which seem to be made largely of carbon dioxide (dry ice). But we also see tantalizing suggestions of glaciation in polar regions, and we can be certain that this glaciation was not done by carbon dioxide, because ice melts under pressure, but CO₂ freezes. Under the pressure of the weight above it, the bottom of a large mass of ice melts; the mass slides, and it becomes a glacier. But under pressure, CO₂ becomes less susceptible to creep, so a CO₂ glacier is a physical impossibility.

Thus, if further research confirms that there are real signs of glaciation on Mars, then they would have to be attributed to water ice. Certainly, astronomers can see some water spectroscopically. There is also evidence of contamination of the CO₂ icecaps by traces of water. But the amount of water seen spectroscopically and the amount we deduce to exist in the polar regions is about 100 million times smaller than the total amount of water that Mars is likely to have, which certainly is not a

very good percentage.

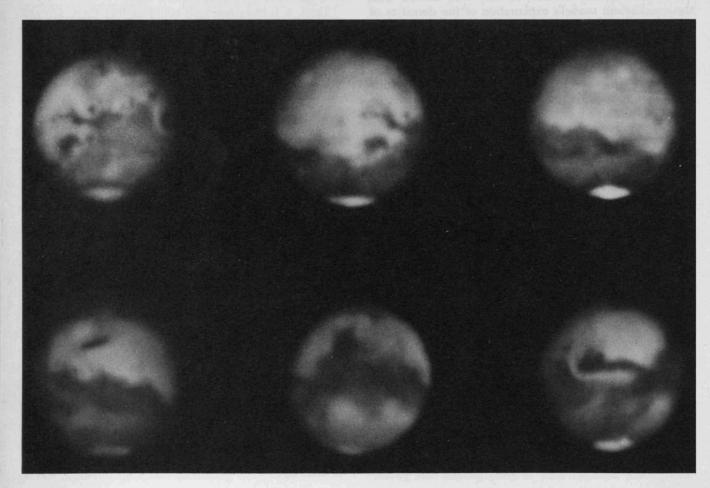
Being a smaller planet than the Earth, Mars has lower internal temperatures. Not only that, it would have a lower internal temperature gradient. That means that a much larger proportion of the interior of Mars could be at temperatures low enough so that hydrous minerals would be stable. It is possible, even plausible, that most of the water in Mars is bound up in minerals, and that only a relatively small proportion of it is avail-

able for formation of a "hydrosphere."

Bruce Murray and Robert Leighton of the California Institute of Technology have argued that the surface temperature of Mars undergoes sizeable periodic variations due to precessional changes in the orientation of its spin axis relative to the plane of its orbit. The eccentricity of Mars' orbit is about 20 per cent, which is quite substantial; the tilt of the spin axis is about the same as that of the Earth's; and the effects of solar tides cause the spin axis of Mars to precess in about 100,000 years. Thus, over each precession period, Mars could go through eras in which the planetary climate changed markedly. An increase in atmospheric temperature means an increase in atmospheric water vapor

Views of two terrestrial (rocky composition) planets. Top: three photographs of Venus, taken between April 26 and June 13, 1967, all in ultraviolet light. Bottom: six photographs of Mars, taken between July 18 and September 3, 1971, all in red light. Both planets were photographed with the 61-inch Catalina Telescope of the Lunar and Planetary Laboratory, University of Arizona, Tucson.





Summaries of the condensation sequences of two models for accretion from the cooling solar nebula. (The equilibrium model was shown in Figures 1 and 2; Fig. 3 showed the lowtemperature end of the disequilibrium or rapid-accretion model.) Steps 3 and 5 in the equilibrium condensation sequence are pressure-invariant. Step 3, Fe + H₂S→FeS + H₂, occurs at 670° Kelvin, regardless of pressure, and step 5, Fe + H₂O \rightarrow FeO + H₂, reaches completion at 510° K., where the FeO becomes a component of the mineral olivine. Pure FeO (wustite) could form only below 470° K. The italicized steps (4 and 7 in the equilibrium sequence, and 3 and 4 in the disequilibrium sequence) take place in the gaseous state, and do not increase the

and CO₂ because it would mean evaporation of the ice caps. This would cause a greenhouse effect, leading to a further increase in surface temperature. Carl Sagan of Cornell University has suggested that the result could be the periodic recurrence of conditions under which life could originate, or Earth's life forms, if introduced, could prosper.

... Meteorites and the Asteroid Belt ...

Up to this point, we have been inferring the compositions of planets from the equilibrium model of the formation conditions of the solar system. Let us now turn it around for a moment; let us attempt instead to reconstruct the formation conditions of meteorites from their observed compositions. After all, we don't really know where in the solar system chondrites originate.

It is a curious fact that all the ordinary chondrites contain a profusion of metallic iron, which indicates in both models that they were formed at higher temperatures than was Mars. That means that the ordinary chondrites probably do not come from the asteroid belt. This is a very unorthodox assertion. Nevertheless, I insist that one should look very closely at the possibility that the common stony meteorites come from between the orbits of Earth and Mars, not from the asteroid belt

between Mars and Jupiter.

What kind of material formed beyond the orbit of Mars in the asteroid belt? The equilibrium model predicts silicaceous material which is very water-richmaterial like the carbonaceous chondrites, which are meteorites very rich in water and organic material. One might suppose that the question could be easily resolved by simply looking at the visible and infrared reflection spectra of the asteroids to see what they are made of. This has already been done to some extent by the M.I.T. Planetary Astronomy Laboratory and by astronomers at Cal Tech, who have attempted to measure the albedos—the reflectivities—of many asteroids. The astonishing result is that there are no systematic trends whatsoever in the asteroid belt. It is a chaotic, highly heterogeneous assortment of bodies whose observed properties are not only very diverse, but are also apparently uncorrelated with distance from the sun. That is a curious state of affairs. Perhaps the asteroid belt is an assembly of debris from different places in the solar system, or some of the asteroids were once large enough to have geochemically differentiated into chemically distinct components (crust, mantle, and core), and were then broken apart by impact. Some complex

Condensation sequence: equilibrium model

- Ca, Al, Ti silicates
- 2. MgSiO₃ and Fe
- 3. FeS
- 4. CO to CH4
- 5. FeO
- 6. talc
- 7. N₂ to NH₃
- 8. H₂O
- 9. NH₃·H₂O 10. CH₄·8H₂O
- 11. CH₄
- 12. Ar
- 13. Ne 14. H₂
- 15. He

Condensation sequence: disequilibrium model

- 1. Ca, Al, Ti silicates
- 2. MgSiO₃ and Fe
- 3. CO to CH4
- 4. N₂ to NH₃
- 5. H₂O
- 6. NH₄SH
- 7. NH₃
- 8. CH₄
- 9. Ar
- 10. Ne 11. H₂
- 12. He

scenario seems necessary to explain the asteroid belt.

In the course of this work, Dennis Matson of Cal Tech made the peculiar discovery that one of the most innocuous of asteroids, Bamberga, which is very faint and unimpressive, is in fact about the fifth largest asteroid in the belt. The reason we don't know more about it is that it has an albedo of about two per cent! Even carbon black requires a certain amount of careful preparation to make it that dark. Matson's work was not based on direct measurement of the diameter of the asteroid, because it is too small and too dark for that. Instead, he measured the body's total re-emission of absorbed sunlight as infrared radiation, and also the visual brightness. The visual brightness is proportional to the reflectivity and proportional to the square of the radius. The infrared brightness is proportional to one minus the reflectivity and proportional to the square of the radius. Thus both the albedo and the radius can be calculated.

Carbonaceous chondrites have reflectivities of from one to three per cent. All other classes of meteorites have albedos of at least 10 per cent. Of course, the albedo alone does not justify classifying Bamberga as identical in composition to a carbonaceous chondrite. It suggests it, but proves nothing.

... the Outer Solar System

Now let us move beyond the asteroid belt.

The Jovian planets seem to be very similar in composition to the sun. But the present evidence suggests Views of two "gaseous" (solar composition) planets. Top: Jupiter and three of its twelve satellites, which, from their calculated densities, are believed to be composed largely of ices. The white dots are, from left to right, Io, Europa, and Ganymede. The photograph was taken by G. P. Kuiper on March 5, 1956, with the 81-inch telescope at the McDonald Observatory, Mt. Locke, Texas. Bottom left: two photographs of Jupiter, in in-frared and ultraviolet, taken with the 61-inch Callisto Telescope at the University of Arizona on January 25, 1968. Bottom right: three photographs of Saturn, in ultraviolet, blue, and infrared, taken between August 25 and August 30, 1969, again with the Callisto telescope.

that several of the largest satellites of the outer planets have densities near 2 grams per cubic centimeter—just what would be expected for a solar-proportion mixture of the rock-forming and ice-forming elements that condense at 50° to 100°K.

Let us therefore make an initially homogeneous body from ice-forming and rock-forming elements, mixed in solar proportions. Let it warm up by decay of longlived radionuclides. It will begin to melt and differentiate when it reaches the melting temperature of the most easily melted major material present. (In this case, as in the case of the Earth, the first thing to melt is not a pure substance. It is, instead, the ammonia-water eutectic, which melts at -100° Centigrade, or 173° Kelvin. The mean daytime surface temperature of Callisto, the outermost of the Galilean satellites of Jupiter,

is 165°K., almost exactly the same.)

We can calculate a thermal model for one of these satellites by constraining the rate of heat loss from the surface to be exactly equal to the rate of heat production in the interior; this is called a thermal steady state. The calculation tells us that the surface temperature is low enough to freeze anything in the satellite. Thus the crust is solid. The satellite's temperature increases rapidly with depth until it is high enough to melt the water-ammonia eutectic, producing a deep liquid mantle in which the temperature dependence on depth is controlled by convection in the ammoniawater solution. Deeper in the interior, we find all the hydrous silicates and the oxide and sulfide minerals, which, because of their high density, have trickled down to the center. All the radioactive elements are in the hydrous silicates, which may familiarly be termed "mud". This picture has occasioned great delight among my colleagues, who usually call it the "mud and slush model."

There are some very interesting aspects of bodies with such a structure. If the satellite accreted homogeneously, the unmelted crust would have the same density as the average density of the satellite. But the rest of the satellite would have melted and differentiated, which produces the curious situation of a crust with a density of two grams per cubic centimeter floating on water with a density of one! Plainly, a small crack from the impact of a meteor would result in catastrophic sinking, melting, and differentiation of the crust. The satellite would be temporarily crustless, but then radiation of heat from the surface would lower the surface temperature sufficiently for the for-

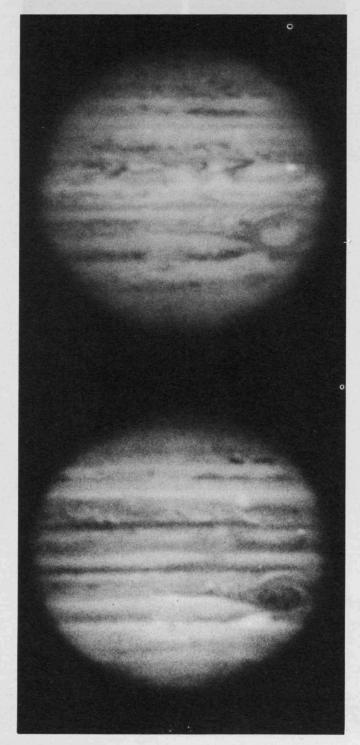
mation of an ultraclean ice crust. We thus expect that a body with a density of two grams per cubic centimeter or less should eventually have a crust that is essentially pure water-ice.

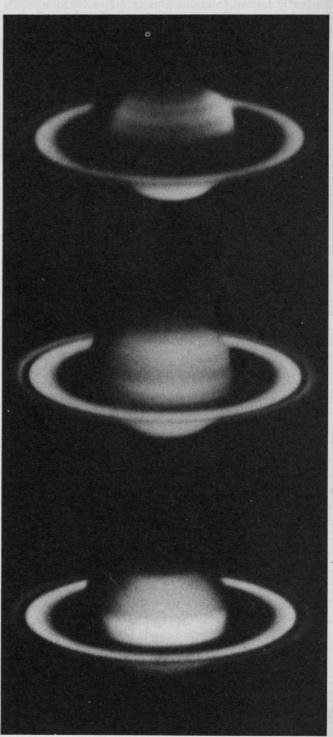
If some methane is present, a methane hydrate crust and even a methane atmosphere are possible. The theoretical temperature profile of the solar nebula predicts that the temperature would first become low enough to retain methane as solid methane hydrate only outside the orbit of Jupiter, probably near the orbit of Saturn. Titan, a satellite of Saturn, is the largest satellite in the solar system. The optical properties of Titan's atmosphere convince us, beyond reasonable doubt, that we are looking into a dense cloud layer in a methane-rich atmosphere. The temperatue in that cloud layer, from infrared radiometric observations, is about 90°K., which is almost exactly the triple point of methane—the temperature at which liquid, solid, and gaseous methane would co-exist. Thus we may be looking through the top of a massive methane atmosphere, into a haze layer of solid methane clouds. Below it may be a fairly dark layer of liquid methane droplet clouds. We see only the bright haze on top, because it is highly reflective. If this is true, it implies that Titan must have been formed at a low enough temperature so that some methane was retained. Fortunately, this agrees quite nicely with everything else we know about conditions at Saturn's distance from the sun.

We have not yet used what we surmise about the outer solar system from the predictions of the two models. But doing so is worrisome, for in the condensation sequences between ice and solid argon, there is only a 10 per cent difference between the sets of densities predicted by each model. We therefore would have to know the densities of the icy satellites to a precision of better than 10 per cent just to decide between the two extremes. If we knew the density to one per cent, we could distinguish between them readily. But how could one measure the density of a satellite to one per cent precision? One would need determinations of the mass and the radius, both to better than one

How many satellites in the solar system have their masses known to one per cent? The moon and Titan are the only ones. We know Titan's because its orbit is in a near resonance with the orbital periods of several other satellites of Saturn. That means that the perturbations they exert on each other do not average







themselves out. In fact, they pile up over long periods of time.

Most of the icy satellites' radii are know only to about 10 per cent. Since the radius enters into the density as the cube, this is a quantitative disaster. Fortunately, Jupiter's satellite, Io, was recently observed to occult a faint star from several widely separated points on the surface of the Earth. Careful observations were made of the time at which the star disappeared behind Io and the time at which it emerged. As a result, the radius of Io is now known to a precision of plus or minus seven kilometers. Last year, Ganymede, the largest satellite of Jupiter, occulted a star, and again observations were made from at least three widely separated points on the surface of the Earth. The radius of Ganymede is currently known to about plus or minus 20 kilometers, based on preliminary analysis of the data. Radius determinations of this precision are adequate for accurate density determinations. Unfortunately, we don't know Io and Ganymede's masses to one per cent!

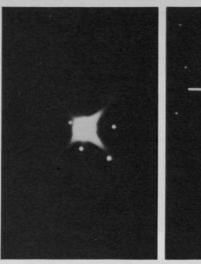
There are two or three small satellites of Saturn for which rough density calculations have been made, suggesting densities of about one gram per cubic centimeter. The uncertainties in these density determinations are large because the mass determination is very imprecise—the precision is plus or minus thirty per cent-and the radii cannot be measured directly; calculating the radii often begins by guessing values

for their albedos.

We are, however, still at liberty to take seriously the possibility that satellites with densities of one gram per cubic centimeter exist. Such a density requires going down either of the two condensation sequences all the way to the point where solid methane is condensed. If we knew the densities of the satellites of Uranus and Neptune, we could test whether temperatures really were that low. Unfortunately, only one of those satellites is large enough and massive enough so that we can make even approximate radius and mass determinations. That is Triton, the larger of the two satellites of Neptune. I recently reviewed the literature on the mass and radius of Triton, and I reached the disarming conclusion that the density of Triton lies between one and forty grams per cubic

centimeter, probably.

The density of Pluto is similarly uncertain. Irwin Shapiro and his collaborators at M.I.T.'s Lincoln Laboratory have recently put the data on the tracking of spacecraft in interplanetary space, the radar tracking data on the planets, and all the available optical astronomical data on planetary positions into a computer, and calculated simultaneously the orbital parameters and masses of every planet in the solar system. The study produced best-guess values for the masses of bodies like Pluto. But it also permitted the researchers to selectively delete bits and pieces of the observational data, solve the system of equations again, and see how much the results changed. In these variational runs, Shapiro and his co-workers found that, about 50 per cent of the time, the mass of Pluto came out negative! I do not advocate a negative mass for Pluto; we just don't know what it is. And not knowing whether the density is positive or negative certainly is not a great help in deciding what Pluto's composition is.





Left: Uranus and its five satellites, on April 25, 1962. A faint dot just above the planet is Miranda; clockwise from there, the others are Umbriel, Ariel, Titania, and Oberon. Right: Neptune and its two satellites, on April 15, 1950. A slight protuberance above the planet is Triton; the arrow points to Nereid. (61-inch Callisto Telescope, Lunar and Planetary Laboratory, University of Arizona.)

Exploring the Solar System

We have now exhausted the list of bodies in the solar system about which we have something to say. Where do we stand? I think we can say some very plausible but fairly simple things about the origin of the solar system. We can conclude that temperature did indeed decrease with distance from the sun. In fact, we find that the densities of the planets are compatible with Cameron's model for the conditions in the solar nebula. That is a strong statement: it means that other theoretical models for the origin of the solar system must produce the same approximate temperature dependence upon distance or they cannot be considered.

Remarkably, it seems that theoreticians have devoted very little of their time to comparing the results of their modeling to the present observational data on the solar system. Faced with the exciting possibilities inherent in designing one's own solar system, many authors have lacked the self-discipline to see to it that their creative art emulates nature. (There is often the heady implication that theory is its own excuse, and nature can fend for itself.) The theorist's art might very well apply to some undiscovered solar system, but what we are really interested in right now is ours. There is an enormous wealth of data on the Earth, the Moon, meteorites, the terrestrial planets, and, in the near future, the outer planets and their satellites, all of which will require assimilation. There will be ever-increasing pressure on the theoreticians to make their models bear some resemblance to the available observational data.

In a more general and speculative vein, what might we expect regarding the likelihood of formation of other planetary systems besides our own? Per se, the present model does not tell us about the likelihood of other planetary systems. But some very difficult astronomical observations have been made of the motions of certain nearby red dwarf stars which seem to show

that these stars follow oscillatory paths in the sky. They are being perturbed by objects in orbit around them which are too small and too faint to be visible to us. The deduced masses for these smaller bodies range from 0.7 to 10 Jupiter masses. In the case of Barnard's Star, and in two or three other cases, the evidence is quite strong. There are about six other cases in which the evidence is marginal; these deserve further study.

All the stars in our neighborhood have compositions closely similar to our sun; they are all Population I stars—the stars found in the plane of our galaxy. The notable exceptions to Population I stars include those stars which have evolved so far that they have altered their compositions and have departed from the main sequence. We have no way of telling whether their original compositions were different from that of our

There is a whole class of stars which definitely do not have the same elemental composition as the sun. These are the Population II or globular cluster stars, the ones that are found in the gas- and dust-free globular clusters and in the galactic core. These stars cannot have planetary systems like our sun's because they are highly deficient in all the heavy elements. If they have planets, then they are planets similar to Jupiter and Saturn, but with smaller admixtures of the

heavy elements.

The models we have been discussing suggest a general mode of dependence of planetary composition on heliocentric distance. They suggest that planetary systems should have rock-like and ice-like bodies, and perhaps solar composition bodies, too, if any protoplanet grows big enough to capture gases. Over the next few years, it will not be possible to test this theoretical construct on other solar systems. Barring unexpected observational discoveries, such tests are decades away. But new observational techniques are constantly being invented: it is very hard to anticipate 20 to 30 years and say what will be observationally impossible then. I conclude only that, with a reasonable extrapolation of present techniques, I do not see any test of that aspect of the theory in the next 30

But exploration of our solar system is a totally different matter. A Mariner probe has recently been launched toward Venus. That planet's gravity will perturb the probe's trajectory inward toward the orbit of Mercury, which it will pass at close range. Venus and Mars have both been repeatedly visited: Russian probes have landed on both Venus and Mars and Mariner 9 and the Soviet Mars 2 and Mars 3 are in

orbit around Mars.

Pioneer 10, launched in March, 1972, is well beyond the outer edge of the asteroid belt on its way toward Jupiter. Pioneer 11, launched in March of 1973, is also on its way there. Current feeling is that it should be targeted to use the gravitational field of Jupiter to deflect and accelerate it in the direction of Saturn.

In 1977 there will be, according to present plans, a launch of a Mariner-class Jupiter/Saturn flyby. The present intent is to target it for a fairly close flyby of any one of the Galilean satellites of Jupiter. Occultation by Jupiter comes free, and with it will come Jupiter atmospheric structure data, obtained by watching the attenuation of the radio signals from the spacecraft as they pass through the atmosphere of Jupiter. When the spacecraft flies by Saturn, we will obtain radio occultations by Saturn and by Titan, and possibly, with a little bit of luck, even get a close pass by another one of Saturn's satellites. A 1977 launch means arrival at Jupiter in 1980 and arrival at Saturn in 1982. The National Aeronautics and Space Administration is presumably now hunting for undergraduates who would be willing to become principal investigators in that program.

Beyond Saturn, it is very hard to make progress, because mission durations become so long that one cannot expect the instruments aboard to survive the flight. A large amount of money will have to be put into creating long-life electronic components. Such efforts are already being made by the designers of communications satellites, who now plan for a sevenyear operational lifetime. A probe could reach Uranus in seven years, so Uranus is probably just within

Neptune and Pluto are still out of reach, but Pluto is approaching the sun, and will temporarily become the eighth planet when it crosses Neptune's orbit in a few years. It is entirely possible that once the space shuttle becomes operational it will be used for directascent launchings of spacecraft toward Uranus, Neptune, and Pluto. To summarize: we may expect to see spacecraft flybys of six or seven of the nine planets within the next few years. Extensive close-up studies of several of the large satellites of Jupiter and Saturn

can also be expected.

It is a difficult matter to try to anticipate the findings of these ventures. Our stunning experience with the Mariner 9 Mars probe-it found enormous volcanoes and river beds-suggests that unexpected discoveries may be the main reward for our efforts. Certainly even the immediately forseeable consequences (such as the prospect of using the chemical and isotopic composition of solar system bodies as clues to their origin, or the likelihood that solar ultraviolet light is presently producing large quantities of organic matter in Titan's atmosphere) are sufficiently promising to assure great returns in new knowledge. But the fundamental fact is that planetary exploration is at its heart an excursion into the unknown. In our first careful studies of bodies as diverse as Mercury, Uranus, and Titan we will be opening whole new vistas on the processes which formed and still continue to shape our own planet. The fruits of such fundamental understanding cannot be easily numbered: How can we anticipate which observations may reflect in wholly unexpected ways on other, apparently unrelated problems? From exploring the solar system, we can at the very least expect a greatly improved understanding of the origin and evolution of the planets. My personal expectations are for a rich harvest of the unexpected.

John S. Lewis is Associate Professor of Chemistry and Geochemistry in the Department of Earth and Planetary Sciences at M.I.T. He studied chemistry at Princeton University (B.S., 1962), inorganic chemistry at Dartmouth College (M.S., 1964), and geochemistry at the University of California, San Diego (Ph.D., 1968). His research concerns the composition, structure, and origin of the planets (and their atmospheres), satellites, meteorites, and comets.

How much earthquake protection should be built into urban structures? The answer is obviously a question of balancing risks against incremental costs. In the case of Managua, Nicaragua (below), writes the author, "the real social costs of allowing inadequately designed structures to be built in a fault zone were vastly underestimated." (Photo: Wide World)



James H. Williams, Jr. du Pont Assistant Professor of Mechanical Engineering, M.I.T. Brute strength does not best assure a building's survival in a major tremor. The problem is not to resist the ground motion but to minimize the earthquake energy that is actually transmitted into the structure.

Designing Earthquake-Resistant Structures

Earthquakes are a result of the dynamic processes within the earth that produce mountains, valleys, and the oceans' ridges and trenches. These processes often generate overstresses under which rocks rupture, releasing energy which produces oscillatory motions of the earth's surface.

Earthquakes are classified as to their magnitude according to the Richter scale, which is a measure of the total energy release in the entire earthquake system. The magnitude-energy relation is empirical and logarithmic; a Richter magnitude of 6 represents an energy release of 10²¹ ergs, which is approximately equivalent to 20,000 tons of TNT or a "nominal" atomic bomb. An earthquake of Richter magnitude 8 has an associated energy release of 10²⁴ ergs or about 1,000 nominal atomic bombs.

A more useful engineering characterization of an earthquake is its intensity, which is a measure of the shaking at a given location. This is often measured on a scale known as the Modified Mercalli. In general, intensity tends to vary inversely with distance from the earthquake epicenter—the point on the earth's surface directly above the focus, the point from which the earthquake appears to originate. Thus many intensities are associated with any single earthquake. (The table on the next page shows approximate correlations between magnitude and epicentral intensity.)

A rational prediction of the effect of an earthquake on a structure requires information about both earth movements and the structure's response characteristics. The former depends on the magnitude of the tremor, the distance of the structure from the focus, and the soil through which the waves must travel and on which the structure rests. The structure's response depends on its vibratory behavior—the modes of vibration and their damping, and the building's possible resonance with the various frequencies of oscillation contained in the earthquake.

Few structures are built in strict accordance with their design. So, the flexibility of a structure, its ductility, its reserve strength, and its energy-dissipating capacity are extremely difficult to predict analytically. So are the characteristics of the earthquakes whose forces may be encountered by a structure during its lifetime. Indeed, the difficulty of predicting the earthquake response of a building may be exceeded only by the significance of the problem.

It is therefore impractical to hope for a detailed understanding of structural behavior and detailed predictions of seismic forces for every building. A more realistic goal is simply to provide sufficient flexibility and energy-absorbing capacity in a building to permit the structure to respond without damage to earthquake

forces typical for the geographical region.

Further, the vital question of what level of protection from earthquakes a society should demand in its structural design codes merits serious consideration. An examination of the building codes in the seismic regions of the world indicates that, where it now exists, earthquake protection is intended to safeguard a functioning economy—not human lives. Countries with relatively large investments in factories, dams, and power plants have sought to protect their investments, whereas the codes of less developed countries require little in the way of earthquake protection.

An analytic approach to the social costs of earthquakes and the level of protection required would relate the cost of protection to the costs—in terms of loss of life, repair and replacement of damaged structures, and loss of production during repairs—of lesser or no protection. Only after such a study can rational decisions be made regarding earthquake protection. For example, the 1972 pre-Christmas tremors in Managua, Nicaragua, left the city without water, food, or electricity. Thousands of lives were lost, many people were injured, and many others found themselves digging frantically to unearth friends and relatives as a geological event became a human tragedy. Clearly in this case the real social costs of allowing inadequately designed structures to be built in a fault zone were vastly underestimated.

Aseismic Structural Design

The primary goals of the design of earthquake—resistant buildings and other structures may be stated as: (1) prevention of serious injury and loss of life; (2) minimizing property damage; and (3) insuring the con-

tinuity of vital community services.

The problem of earthquake-resistant design cannot be met simply by attempting to make a structure stronger by adding material (mass) to it. The force imposed on a building by an earthquake depends on the acceleration resulting from the earthquake and on the mass of the structure; the newtonian relation between mass, acceleration, and force pertains (F = m·a). Given two geometrically similar structures that have the same acceleration input, the more massive one is subject to the higher dynamic forces. Thus, careless over-

The Richter magnitude is a measure of the total energy liberation of an earthquake, and the Modified Mercalli Intensity Scale is a measure of the shaking at a particular site. This table gives approximate correlations between magnitude, epicentral intensity, and ground acceleration.

Richter magnitude	Acceleration gravity fraction	Modified Mercalli intensity scale	Richter magnitude	Acceleration gravity fraction	Modified Mercalli intensity scale
2		Not felt except by a very few under especially favorable circumstances. Felt only by a few persons at rest, especially on upper floors of building. Delicately sus-	6	0.1g	VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse great in poorly built structures. Panel walls thrown out of frame structures. Fall of chim-
3	0.01g	pended objects may swing. III. Felt noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing truck. Duration estimated.			ney, factory stacks, columns, monuments, walls. Heavy furni ture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturb persons driving cars. IX. Damage considerable in specially designed structures; well
		IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking buildings. Standing cars rocked noticeably.	7		designed frame structures thrown out of plumb; damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Under- ground pipes broken. X. Some well built wooden struc-
4		V. Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may		0.5g	tures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.
5	0.05g	stop. VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.	8	1.0g	XI. Few, if any (masonry), structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
		VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; some chimneys broken. Noticed by persons driving cars.			XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

Magnitude	Number of earth- quakes in 100 years		
4.75—5.25	250		
5.25—5.75	140		
5.75—6.25	78		
6.25—6.75	40		
6.75—7.25	19		
7.25—7.75	7.6		
7.75—8.25	2.1		
8.25—8.75	0.6		

Data on the probable frequency and magnitude of earthquakessuch as this for the 150,000 mi.2 area of California—is an essential input in the analysis of how much earthquake resistance should be required in construction of various types of structures. But rational decisions depend also on careful analysis of the cost of protection compared to the cost of potential damage in terms of replacement, temporarily lost productivity, and loss of

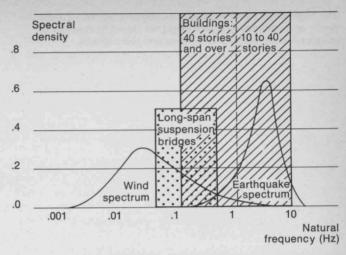
design that increases the mass of a structure is often as detrimental as careless underdesign. Details that may appear to be insignificant become critical, since it is often the weakest link that has to absorb a large part of the energy. Thus, the weakest link is the only link that may ultimately matter.

Low-profile structures built on firm soil behave almost like rigid bodies when subjected to earthquake motion. Most of the earthquake energy is contained in vibrations that are below such buildings' natural frequency—the frequency at which the building would resonate. Thus, the entire structure undergoes about the same motion as the ground on which it rests, and designing into such buildings sufficient lateral strength to resist serious earthquake damage appears to be relatively straightforward.

Considering that the majority of a population typically resides in such low-profile structures, it is perhaps surprising that they have been largely overlooked by engineers, and that many building codes completely ignore them. It may, however, be argued that all that is needed for the adequate aseismic design of such structures is the firm adoption of the ancient Code of Hammurabi, the first known written code relating to the design of buildings. It was rather specific in its quality demands of construction: "If a builder build a house for a man and do not make its construction firm and the house which he has built collapse and cause death of the owner of the house—that builder shall be put to death." It was a code which encouraged neither incompetence nor innovation.

Very tall structures having 50 or more stories are comparatively flexible and have long natural periods of oscillation relative to earthquake excitation. Their dynamic response to seismic ground motion is almost completely elastic, and they tend to have a natural isolation against earthquakes.

The dynamic behavior of mid-height buildings of 10 to 40 stories is a more serious problem. Some of the vibrational frequencies predominant in earthquakes coincide with natural frequencies typical of such build-



The dynamic response of structures to excitations-either wind or earthquakes—depends critically on the presence or absence of resonances between the structure and nature. This chart shows the spectral densities—a convenient description of the way in which energy is distributed over the various frequencies of excitation—of wind and earthquake compared with those of suspension bridges and of buildings of various heights. Note that winds pose a hazard to suspension bridges and earthquakes to moderate-height (10 to 40 stories) buildings.

ings, and the result is likely to be a resonant action within the building which magnifies the ground motion caused by the earthquake.

Present Design Philosophy

The dynamic behavior of a structure subjected to an earthquake depends on two general factors-the amount of ground motion or force that is applied to the structure and the structure's response to that input. All design philosophies require the recognition of these two factors.

The present widely accepted philosophy for designing earthquake-resistant structures does not explicitly treat the first of these factors as a variable; it assumes at the outset that the motion of the base of the structure must be essentially the same as that of the ground at its foundation, and it assumes on the basis of historical precedent some probable maximum energy input which the structure must be designed to resist. Briefly, the emphasis is to make the structure safe by building it stronger, so it should be able to undergo:

-Frequent minor-to-moderate earthquakes with only

small damage.

-A strong-motion earthquake, the "design earthquake," with moderate damage; it is expected that considerable inelastic deformation will occur.

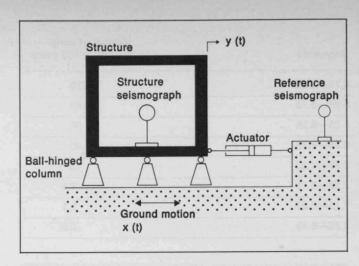
—An earthquake that is somewhat stronger than the

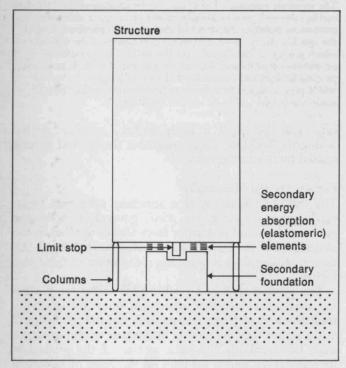
design earthquake without collapse.

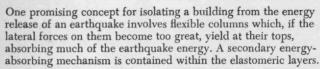
This philosophy is based on the implicit assumption that the design engineer can reasonably predict those loads the structure will encounter during its lifetime. In a real sense, the designer is wagering that nature will view his work with benign respect and so produce few if any forces that exceed certain specified design and collapse loads.

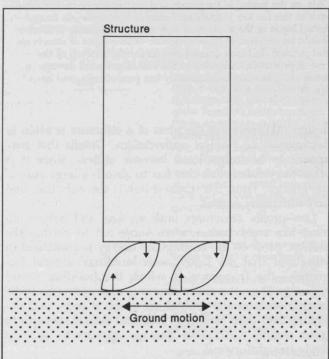
The designer is not without tools in his undertaking. He has at his disposal both the recent (few hundred years) history of major seismic occurrences and the art of probability. But the history of earthquakes does not define their future, for few forces in nature are as unpredictable or as devastating as earthquakes. So even

The high-speed servomechanism earthquake isolation system depends on a complex feedback loop (not shown) between the reference seismograph and the structure seismograph.









The "rocking ball" system for isolating a building from earthquake forces in the ground is especially useful where small vertical motions in the isolated structure are acceptable. The inclination of the egg-shaped elements serves to convert horizontal ground motions into smaller vertical ones, and the system has the advantage of a natural restoring force—the weight of the building acting at an eccentric point on the balls.

a meager knowledge of probability might result in some sleepless concern for the resident in an earthquake zone.

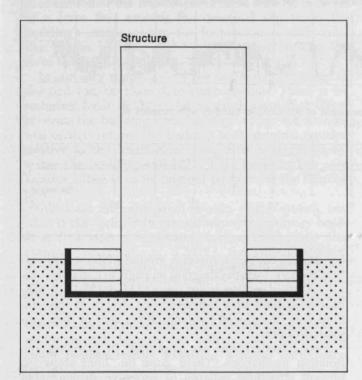
An Alternative Philosophy

There is now developing a more positive approach to the aseismic design of structures. This alternative philosophy is based on controlling the level of the earthquake forces that the structure experiences. We now know that the earthquake forces that actually reach the structure need no longer be considered as immutable inputs; they can be limited by what is commonly called an isolation mechanism. In brief, the emphasis of this philosophy is to make the structure safe by protecting it in lieu of making it stronger.

The general concept underlying an isolation mech-

anism is this: if a deformable element is deliberately built into the structure, the force that can be transmitted to the structure can be no greater than the deformable element can conduct. A properly deformable element can then establish at a safe level the maximum force that can reach the structure.

"Flexible" or "soft" stories in buildings have been discussed in the literature for more than 40 years, but this dialogue has as yet had little influence on the practice of structural design. However, observations of the behavior of multi-story buildings in the 1963 Skopje (Yugoslavia) and 1967 Caracas earthquakes stimulated new interest in this concept. It was noted that buildings with an open ground story for parking or commercial use had little damage above that story, while similar buildings with walls that extended to the ground suf-



A double basement surrounding a tower is an effective mechanism for maintaining even distribution of mass-and low absolute mass-in the tower, which is the most vulnerable form of building to earthquake oscillations. The massive reinforced concrete retaining walls are in the outer basement, which is maintained separate from the basement of the tower.

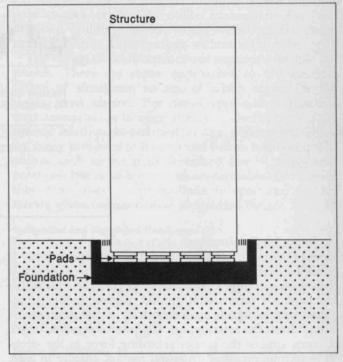
fered serious damage in walls and partitions throughout the entire height of the building. The "soft" stories appeared to provide a shielding effect, absorbing the shock while significantly limiting the damage to the upper stories.

Can such an "isolation mechanism" be deliberately provided to control earthquake damage? Many problems must be considered, and among them are the criteria for assessing the relative merits of alternative mechanisms.

-The structure should not collapse during the operation of the mechanism.

-Irreversible deformation of the structure should be negligible for even the most severe earthquake antici-

-Permanent displacements of the structure relative to



This system of pads on which a building "slips" if earthquake forces become dangerously large has been devised by the author. In a severe earthquake, the pads absorb energy, permitting the building to stay in place under the force of its inertia while the foundation moves with the ground motion. Computersimulated tests of the system have produced results shown on the next page.

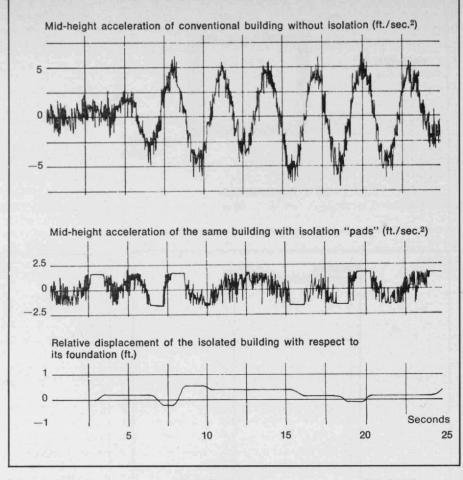
the foundation should be tolerably small.

—The effectiveness of the isolation mechanism should not be impaired by aging.

-The mechanism should be completely contained and its operation unaffected by accompanying effects of an earthquake-for example, by loss of power due to interrupted electrical lines.

-The total cost of any particular mechanism-including the initial cost, repair cost, and societal costsshould be less than the cost of any alternative approach. Depending on the nature of a given application, certain of these conditions may be relaxed. For example, permanent displacements which may not be "tolerably small" are likely to be preferred to the collapse of an active nuclear reactor.

This computer-drawn chart shows how the system of isolation "pads" now under study by the author would reduce the acceleration in a building due to an earthquake. The top curve shows the movement of a point at the center of a building rigidly attached to its foundation; the increasing amplitude from 5 to 10 sec. shows a resonant response of the building to the earthquake motion. Isolation "pads" (middle curve) clip the building acceleration at whatever the level designed into the pads. The bottom curve shows relative displacement between the building with pads and the foundation.



Isolation Mechanisms

Among the most sophisticated isolation mechanism is a high-speed electrohydraulic servomechanism which is based on a complex feedback loop (see the illustration on page 40). Horizontal ground motions induce structural motion which is detected by a seismograph. A signal from the seismograph triggers an actuator which in turn applies the proper retarding force to the structure to minimize the structural motion, ideally to zero. Many limitations of this system, including the problems associated with the size required for an actual building and its stability under random excitation have conspired to keep it in the back of the laboratory.

The flexible-story concept in the left-hand illustration on page 40 appears to be more practicable. The system is designed so that if, during an earthquake, the dynamic lateral forces on the structure exceed the design limit, the columns of the structure will yield at their tops; the motion is then further damped by an elastomeric layer—blocks of thick rubber, for example—in which the remainder of the energy can be harmlessly absorbed by deformation. The effect is to limit all permanent deformation to the "soft" story while the remainder of the structure undergoes only reversible elastic motions. The possible instability of this system under ground motions larger than those anticipated in the design has caused some concern and remains unresolved.

A similar system of flexible columns and energy-absorbing elements can be used below ground level in the foundation. Forty-percent reductions in the force on the structure have been reported for computer models of such a system.

The rocking-ball system, in which egg-shaped mount-

ing devices convert transverse ground motions into vertical motions (see the diagram on page 40), may be useful if vertical motion is not serious. Model tests of ballbearing systems have suggested that structural accelerations may be reduced to about 50 per cent of their unisolated values.

Two considerations are important in planning any isolation mechanism. There must be "limit stops" to prevent structural collapse or excessive displacement between ground and structure in the event of a shock significantly greater than the design anticipates. And, the isolation mechanism must not be so sensitive that it is triggered by wind forces. The latter stipulation does not represent a critical issue under most wind conditions; but transverse loadings due to hurricanes may reach the activation loads of some isolation mechanisms. However, forecasting of such severe wind conditions comparatively reliable; so, when a hurricane threatens, for example, the isolation mechanism can be temporarily locked. The probability of the simultaneous occurrence of hurricane winds and a major earthquake is fortunately essentially zero.

Other Aseismic Methods and Devices

Other concepts which cannot truly be termed isolation mechanisms have also been studied to reduce the seismic forces applied to buildings.

The distribution of mass is one of the most important factors in aseismic design of multistory buildings; the goal is to achieve a smooth distribution of mass from the basement to the superstructure, because vibratory stresses are likely to be concentrated at points of mass discontinuities. Such a smooth mass distribution is often

a useful product of the "double basement" plan, in which a relatively massive outer basement construction of reinforced concrete surrounds an inner basement structurally very similar to the building superstructure (left diagram, p. 41)

Pads—a New Isolation Proposal

A comparatively elementary system for isolating a building from its foundation is presently being investigated at M.I.T. The plan is to erect a building on pads which themselves rest on a foundation that may be considered rigid (right diagram, p. 41). The pads are designed to limit the maximum horizontal load that can be transmitted from the foundation to the structure. If an earthquake moves the building's foundation slowly, the pads and superstructure move with it. But if the acceleration of the foundation is rapid enough to result in a force that exceeds the designed slip force, the building's inertia causes the foundation to slide relative to the building and the pads, thus limiting the force that can be applied to the building.

In our very simple model the horizontal resistance of the pad can be likened to static friction. There is no restoring force in the isolation mechanism that either prevents the building from "skating" across the founda-tion or that returns the building to its original position relative to the foundation. Thus after a severe earthquake the building will likely have come to rest at a location other than its original position on the founda-

What are the anticipated benefits of this system, and what is the "price"? In general terms, the primary benefit is that after a moderately serious earthquake (for example, magnitude of 6 to 7), the structure would ideally be undamaged. And even after a major earthquake (magnitude greater than 7), the structural damage would be very small. The "price" is the final relative displacement between the structure and its foundation; this would mean that utility connections and such environmental features as entries and landscaping might require repairs following a major earthquake, but such work would be modest compared with the structural damage the building might otherwise sus-

We have considered the costs and benefits of this isolation system with a computer model using data from the 1940 Imperial Valley (El Centro), California, earthquake which registered a 7.1 magnitude. Until recently (1971) the records of the El Centro earthquake were the best strong-motion data ever obtained in the United States. Lateral ground displacements as great as 19 ft. were documented. The Modified Mercalli Intensity was X along the fault and IX in the cities of Brawley and Imperial (see the chart on p. 42).

Our computer program was arranged to show the effects on a building of random "white noise" ground accelerations equivalent to those recorded in 1940 in El Centro. The illustration on page 42 shows one of the many sets of earthquake response results we have obtained. The top curve is the centroidal acceleration of a building that is rigidly attached to the ground. The increased amplitude that begins around six seconds is illustrative of the resonant build-up that can occur in

The middle curve shows the acceleration of the same building when the isolation pads are employed. The acceleration level is "clipped" at the limit force level designed into the pads. For this case, the maximum centroidal acceleration, and thus the maximum inertial force, in the isolated structure is about one-fourth that in the conventionally unisolated structure. The "price" for this reduction in acceleration is illustrated by the bottom curve, which shows a maximum relative movement of the building on its foundation of about seven inches and a final offset of about five inches.

We are continuing studies of this system to investigate the effects of changes in the natural frequency and damping of the structure and of the introduction of damping and non-linear characteristics into the pads. We also propose that restoring spring elements may be introduced into the pads to restrain the building's ultimate displacement, ideally reducing it to zero. But analyses of those cases are complicated considerably by the non-linear effects that are introduced. We also propose studies of flexible utility connections for padmounted buildings which would withstand the structure-foundation displacements without serious damage.

The design of flexible structures requires a flexible approach. There are many approaches to the aseismic design of structures, no one of which represents the single ideal choice. For some applications isolation mechanisms seem to offer attractive alternatives to the present earthquake-resistant design philosophy. There are many problems to be resolved before isolation mechanisms such as the pads described can be considered practical; but none appears insurmountable. But even if they were, they would continue to command our interests, given the alternative of ignoring them.

References and Suggested Readings:

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Proceedings of the Third World Conference on Earthquake Engineering (New Zealand), 1965.

Proceedings of the Fourth World Conference on Earthquake En-

gineering (Chile), 1969. Wiegel, R. L., editor, Earthquake Engineering. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970.

James H. Williams, Jr. received a certificate as Mechanical Designer from the Newport News Shipbuilding and Dry Dock Co. Apprentice School, S.B. and S.M. degrees from M.I.T. and holds a Ph.D. from Trinity College, Cambridge. He is currently active in research in continuum mechanics of solids, with particular emphasis on advanced fiber composites and non-destructive testing of structures. The new isolation proposal described in this article is proceeding under a grant from the National Science Foundation in which Professor Williams is collaborating with Professor Stephen H. Crandall and Mr. Samson S. Lee.

Concern for the impact of all its activities on the total welfare of society is a matter of self-interest for every U.S. corporation. Many sectors of our society, including the investor, act as catalysts to reinforce this relationship

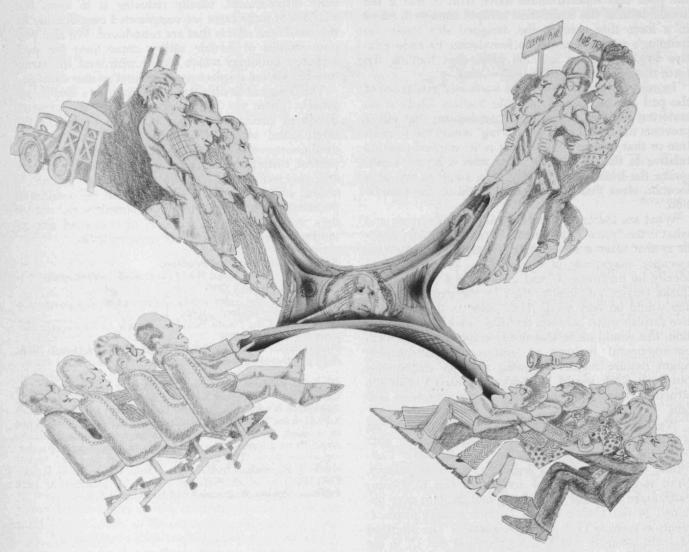


Illustration by Jerry Dadds

Corporate Social Responsibility and the Investor

Two hundred years ago Adam Smith in The Wealth of Nations proposed that the market place provided the form of provident control necessary to keep the activities of a business, through self-interest, in the best interests of society. Does it really work that way, two centuries later?

It is the purpose of this paper to suggest that, though our economic system is immensely more complex than any envisioned by Adam Smith, his view can be logically extended: a "neo-invisible hand" is present in contemporary western society which constrains the activities of business in a manner not unlike the markets of Adam Smith. Corporate social responsibility today is dependent solely upon neither the noblesse oblige of the manager or the laws of the government; and corporate social responsibility is not at all in fundamental conflict with the interests of the investor.

The question of corporate social responsibility has been raised most visibly in the last several years in the context of the investor. It has been at annual stockholder meetings of a succession of large and successful American companies, starting with "Campaign GM" (General Motors), where there have appeared proposals on such issues as the composition of the board of directors, the legality of pollution and the company's role in environmental damage, discrimination in employment and promotion for reasons of race, religion, or sex, disclosure of information in annual reports, weapons manufacture, and business operations in certain overseas areas where political and social policies are seen as repressive.

In virtually every case these proposals have been contested by the companies with the Securities and Exchange Commission (S.E.C.) as not appropriate for stockholder vote. However, the S.E.C. has approved many of them for stockholder voting, some in modified form, and many of the issues have been voted upon at corporate annual meetings. Institutional investors who are charitable institutions-foundations and universities, especially, have given most careful consideration to these proxy questions. It is true that in every case, the majority of shares voted (many by proxy) has been in support of positions taken by company managements and against those of the advocate groups. But at least some of the latter have acknowledged that their real goal was awareness of the issues by stockholders, management, the government, and the general public, and surely the campaigns have achieved this purpose. It is clear that the social responsibility of a company-however defined—is a larger issue in the minds of many investors than ever before.

Little research following the canons of social science has been carried out in this area. This article draws on the author's previous study for M.I.T. (University Investing and Corporate Responsibility) which included interviews with 50 business executives, institutional investors, advocate groups, and governmental professionals; analyses of these issues and actions taken received from 65 universities and colleges, a general survey of the literature-including books, journal articles, newspaper clippings, proxy proposals, and company releases—and a number of interviews in Europe, largely with Belgian executives and institutional investors. What is offered, then, is essentially a broad but casual empiricism.

Corporate social responsibility is not easily defined. For the moment let it be thought of as determined by the impact of all a corporation's activities on the total welfare of society. Some analysts may define anything that ultimately benefits the corporation as not falling within the definition of "socially responsible behavior" simply because it benefits the company; but this is too narrow a definition for the present purpose, and it misses most of the useful and interesting questions involved. A more useful approach is to draw upon and extend the economic concept of externalities to try to shape some of the issues. While many of the costs and benefits of a corporation's activities are reflected in its expenses and revenues and subsequently in profit and loss statements, some effects are not so reflected; these are referred to as externalities, and it is this concept which becomes the point of departure here.

Corporate Social Responsibility

The economic efficiency of a corporation's decisions and activities is considered by many, especially economists (e.g. Professor Milton Friedman), to be a principal feature of the social responsibility of an industrial corporation. The corporation acquires and uses the limited resources of society—labor, materials, equipment, land and converts them into products and services which society in turn purchases for its own use. If the market system works reasonably well, these markets and their prices reflect the costs and preferences of society.

According to this view, the corporation which manages this conversion more efficiently than another is better serving society and hence performing more responsibly. Profits are a short-run indication and scale of this performance, and in the long run it is measured by return on investment (equity or total). Clearly under this definition social responsibility is beneficial to the

corporation and to its stockholders.

Most of the costs of a corporation's activities are reflected in its books of accounts, and most of the benefits and values produced by the corporation are captured in its prices and are therefore also reflected in its profits and return on investment. However, this is not necessarily true of all its social costs and benefits, and the concept of economic externalities—unreflected costs and benefits—must be introduced to modify the preceding oversimplified statement of social responsibility.

Pollution is a useful current example of such a social cost or negative externality. A factory placing some pollution into a stream (even if it has already incurred costs to reduce pollution) will not normally reflect in its books the cost of that pollution to downstream water users, including perhaps fishermen, householders, industrial water users, municipal water supply systems,

swimmers, etc.

Positive externalities, or social benefits, also exist to complicate the analysis. If a corporation which has a choice between relatively educated and skilled employees and disadvantaged, perhaps ghetto, employees chooses to recruit, hire, and train the latter at some added expense, it often has no possibility of capturing that expense in the prices it charges for its products. And yet benefits accrue to society—the individuals hired and trained as well as their families, their communities and perhaps stores in their communities, the government through personal income tax collections and perhaps reduced welfare payments, and even subsequent employers—because of the choice.

The situation is a complex one for analysis. Many corporate activities which at the time are seen as externalities may in fact turn out to benefit the corporation in many concrete ways and over the longer run. In other words, what is truly an externality, which by definition means not (ever) to be reflected on the com-

pany's books, is very often difficult to ascertain.

What do positive and negative externalities mean to a corporation and its stockholders? Activities in at least three categories can be identified in any economic consideration of stockholders' interests and future returns to the corporation from potential positive and negative externalities.

One group of activities are those with positive social effect which will almost surely economically benefit the

corporation. These would include, for example, many safety measures within the company's own plants; employee turnover, for example, can be reduced, pay rates for special dangerous jobs can be lower, insurance claims will be fewer, law suits will be less likely. At the other extreme, one group of activities can be identified which almost surely will not directly benefit the corporation; these might include gifts to charitable organizations, especially those which are geographically remote from the company's operations.

In between these two are a series of activities of uncertain return to the corporation which clearly impact the total welfare of society. These might include expenditures for materials and quality control felt to be related to issues of "consumerism." Activities addressed to customer service, parts, and repairs might be included here. Some research activities, especially where the results are made available to the public, might also

be classified here.

The issue of whether the corporation does or does not benefit from these activities may depend importantly on the company's ability to "internalize" these benefits. A public guarantee of service on its products may capture for a corporation the otherwise ad hoc expenses and their benefits, especially for all those customers not needing the repair/replacement service and treating the guarantee as value received. Patents may do the same thing for research and development benefits, and advertising for product quality.

Whether or how much the company benefits economically may depend on the level of expenditure for many activities which impact the welfare of society. Up to some level of expenditure, for example, funds spent to recruit, train, and place, minority employees will benefit the company. But if funds are provided to train minority employees beyond the company's own requirements for new workers, then the company's bene-

fit is probably lower.

Economists tend to describe a company in this situation as a company "taxing" itself. The implication is that expenditures made for society's welfare and with no economic return to the company are analagous to a tax levied on the company by its own management (and without political legitimacy and sanction). However, with oligopolistic competition or "administered prices," some of the increased cost might be included in the negotiation of prices with customers, including the government. And the issue is still unclear, in the sense that maximizing return to the company may not be an acceptable, unique goal for managers, investors, or others who may opt for larger social expenditures on certain activities at the expense of lower company returns.

The third puzzle to be mentioned deals with the time frame of certain socially related expenditures. For example, where a state has announced that air purity requirements will be raised to a certain level at a certain time, a company may choose to begin work on air pollution controls at a time far ahead of the deadline in order to be sure of meeting the new standard when effective or to control the costs of doing so. The result is that for a considerable time the company's performance is better than that required by state law; whether such action falls under the label of "corporate social"

responsibility" is a moot point.

The Neoinvisible Hand

At a minimum, the previous discussion has been intended to abolish the myth that there is a simple conflict between corporate social responsibility and either the welfare of the corporation or its stockholders, espe-

cially in the case of potential externalities.

The argument put forth here is that many sectors of an industrial society influence (constrain) the activities of business with a neoinvisible hand, not unlike the markets posited by Adam Smith. Any organization, commercial or otherwise, must maintain a "viable coalition" of all its constituents; it must in some sense be responsible to/for many parties, including its owners, employees, management, customers, communities, government, and vendors.

The case can be documented from both European and American experience with strikes, boycotts, lawsuits, equity security sales, and refused building permits—expressions by many sectors of industrial society related to a corporation's negative externalities. Similarly, increased sales, reduced employee turnover, and favorable tax treatment have been associated with positive (potential) externalities. Such explicit actions, and also the latency of such power and actions, may be regarded as the neoinvisible hand.

It is not solely on the conscience of the manager, nor on the government, that the welfare of society is protected, promoted, or interpreted. That role belongs potentially to any and all elements of an industrial society, and the investor must see his interests as a complementary part of these pluralistic institutions. His corporation (investment) can operate and survive in no other way than as a negotiated part of this environment.

Though constrained, more or less strongly, by a market economy, management chooses which goals and subgoals it will seek and the manner in which it will seek them. Social goals are included in this portfolio. Investors should realize that they are but one of the constituencies to be served. The negotiating constituencies of the neoinvisible hand include as well customers, unions, communities, governments, and employees.

The Investor and His Perceptions

Many institutional investors interviewed in Europe and in America indicate their belief that an appropriate concern for corporate social responsibility on the part of a company is a sign of good management and therefore consistent with and necessary to a good investment. A university executive committee policy resolution states that it is "prudent to invest only in the securities of corporations in whose management (the committee) has confidence as being not only able and efficient but also responsible to the public interest, because these are the corporations that will produce the best long-term results." An American banker states that, "... beyond pure economic issues, any corporation must operate within the social and political structure of the times...."

This view is widely shared, and it is probably based on at least three rationales. One is that good investments require good company management, and good management is evidenced by—among other things—concern about and involvement in the general social and economic problems of our times. Another is that successful, profitable companies have sufficient resources to allocate a portion to social concerns, and their social responsibility is thus evidence of the power and flexibility of their resources. The third, most pragmatic view is that corporate activities and expenditures for social concern at an adequate level are simply in the self-interest of the firm, and such investments simply are a mark of corporate efficiency.

A somewhat different way to capture these arguments in summary is to say that the risk associated with a given investment is lessened in companies which demonstrate adequate social concern. So it is that the market's perception of a corporation's responsibility may affect the price of its stock and therefore the investors' return (where both dividends as well as capital gains are considered as included in total return). The price of its stock, in turn, will have subsequent effects on the cost of capital to the growing company and ultimately

on its earnings.

A different aspect of this argument is an extension of the concept of risk vs. return. We generally accept the proposal that risk and returns are positively (but perhaps imperfectly) correlated; in other words, the investor seeking the greater return must accept the larger risk. Many institutional investors now argue that the corporation which is not responsive to corporate social responsibility will be a more risky investment. To oversimplify the argument, this may be equivalent to stating that the corporation not socially responsible may be an undesirable investment for its stockholder; he might have hoped to obtain a lower risk (in the sense used here) with the same return or, if he had so chosen, a higher return with the same risk. Recent finance theory

and empirical work suggest that risk which is not correlated to general market risks has no rewards.

An interesting argument has been made for the economic interest of diversified stockholders in corporate expenditures for socially beneficial activities or externalities. It is best made in the words of Henry C. Wallich and John J. McGowan in their chapter on "Stockholder Interest and the Corporation's Role in Social Policy" in A New Rationale for Corporate Social Policy: In the case of stockholders who choose to hold their wealth in equities in many corporations, "it would be contrary to the stockholders' interest for individual corporations to adopt the narrow-based approach which instructs each corporation to look only at returns appropriable by it; (this approach) is the keystone of arguments advocating a minor role in social policy for corporations. If there are investment opportunities which would lead to improved environmental conditions, a better labor force, or whatever, and the returns appropriable by the corporate sector as a whole exceed costs, then they should be seized. Not to seize them deprives investors of returns they might otherwise enjoy. . . . The conclusion of this analysis is that the proposition that corporation involvement in social policy is contrary to stockholders' interest is both misleading and irrelevant . . . once it is recognized that corporations are . . . usually owned by individuals who as a group typically own shares in a very large number of corporations . . .

In the case of the Swedish economic recovery from the recession of the late 1960s, it is maintained by a number of analysts that the recession was shallower and the recovery quicker because of the impact of capital investment for pollution control. For those governmental economists looking for counter-cyclical investments (forced or subsidized by the government), such expenditures may be more socially useful than building pyramids. This involvement is not contra to the Wallich-McGowan argument for "voluntary" expenditures for externalities as being in the interest of the diversified investor. It is also in the spirit of John K. Galbraith's new industrial state, where the government side of the partnership assumes the responsibility for stable national growth (an obligation not always satisfactorily performed).

The "Ethical" Investor and His Problems

It is clear that many investors have financial reasons for concern for the social responsibility of the companies

in which they are invested. They may also have ethical reasons. Each stockholder is an owner of the corporation, benefits from the corporation's activities, and has invested in the corporation for those benefits; and many stockholders feel, at least in part, responsible for these activities. Universities and foundations, as institutional investors, are the most obvious examples of investors who have taken this position. In our study for M.I.T., a committee for another university wrote us that "there has emerged almost a moral imperative to take seriously our responsibilities. . . . As stockholders, we agree that the university must assume some accountability for the activities of the corporations whose ownership we share." A large pension fund manager has stated, "... Even though you are the trustees of other people's money, you still ought to step up to bat on these noneconomic issues. With size comes responsibility, and you cannot escape it because on issues like this not taking a stand is effective action."

Banks and insurance companies, both in America and in Europe, seem commonly to consider the moral and economic issues as so closely interrelated (for the reasons of the viable coalition of constituencies as previously discussed) that they consider any separate

question of morality as highly hypothetical.

Shareholders and trust beneficiaries queried recently in a number of surveys by commercial investment managers have agreed that investments should be made on the basis of analyses which include what is here called corporate social responsibility. An overwhelming majority of shareholders of the Wellington Fund, for example, perceived a close correspondence between economic performance and corporate social responsibility; but even more interesting was the response to the following proposition: "Even if other companies offer better investment prospects, a mutual fund should invest only in socially responsible companies . . . i.e., those that avoid pollution with their manufacturing plants; those concerned with product safety; those that do not discriminate in their hiring practices." Of the Wellington Fund's respondents (28 per cent of its 6,500 shareholders), 27.3 per cent "strongly" agreed and 28.8 per cent "generally agreed."

A Belgian banker, who feels he would know of such a survey in Europe, believes none has been conducted. He also believes that the concern about corporate social responsibility so visible in the United States today is less felt in Europe—and certainly less felt among investors; but he thinks that Europe will pass through

After its direct costs are met, how shall a corporation divide its remaining funds between the several competing purposes? How high is the priority to be assigned to issues of social responsibility? To what extent should stockholders and public interest groups affect these decisions? This is an arena in which there are fewer answers than questions.



Illustration by Jerry Dadds

the same stages as America, delayed perhaps by five years.

Stockholders concerned for social responsibility who prefer a mutual fund investment can now choose from at least half a dozen "clean funds," each of which has as part of its prospectus or charter the requirement to invest only in social benefactors, as measured in some

way by the fund's own procedures.

In its May, 1971, prospectus, the Dreyfus Third Century Fund, for example, indicates it is "seeking capital growth through investment in companies, which . . . not only meet traditional investment standards but which also in their corporate activities show leadership in, or have demonstrated their concern for, improving the quality of life in America. . . . Activities in the areas of the protection and improvement of the environment and the proper use of our natural resources, consumer and occupational safety, product purity and its effect on the environment, equal employment opportunity, and the health, education, and housing demands of America will be considered by the Fund in its investment selections. . . . There are few accepted standards in this area of the Fund's objectives, and the development of suitable standards will be largely within the discretion and judgment of the management of the Fund."

The Dreyfus Third Century Fund suggested in this prospectus that "the introduction of the additional (social responsibility) criteria as an element of portfolio selection and evaluation may encourage companies to take action which will make their securities eligible for purchase by the Fund. Other investors may be encouraged to use similar portfolio management techniques, and the Fund would hope that its policies will have a positive effect in influencing corporate action."

While the total investments of such new mutual fund institutions may not yet be large in relation to the total market, they may grow in time so that their investment behavior does in fact influence the price of stock and, as previously argued, the earnings of a corporation and therefore the return to the stockholder—as well as corporate behavior through the mechanism suggested in

the Dreyfus prospectus.

In their early existence the new "clean funds" did not perform as well as in the market place as their competitors (all mutual funds). Though it is clearly too early to make a judgment on their prospects, one way to highlight the problems of such funds is to compare their approach to that of many universities, who are also institutional investors with a concern for corporate social responsibility (and externalities).

On the scale of corporate social responsibility, however constructed and measured, the large majority by far of corporations can be considered in the middle ground—neither outstanding for their demonstrated social responsibility nor flagrantly ignorant of it. The large survey conducted for the M.I.T. report suggested that universities, by and large, concern themselves as investors only with the social responsibility issues raised by the small minority of corporations which they might consider the "flagrant cases."

Given the large number of alternative investments currently available, these corporations can be excluded from a portfolio with no discernible negative effect on either the total return or the total risk. However, an investor who chooses to focus on the small minority of corporations at the other extreme, the "outstanding social benefactors," faces a substantially different problem; his range of choices is small, and his portfolio's diversity, risk, and return may all be adversely affected.

Stockholder Influence

Currently some of the most visible issues raised for stockholder voting under the rubric of corporate social responsibility are more "political than economic." They deal with the rights of the stockholder to know and to nominate. Advocate groups have unsuccessfully attempted to obtain proxy votes requiring corporations to leave South Africa; they have now turned to the somewhat less ambitious and more saleable idea of demanding disclosure of corporate activities—employment distribution and pay scales—in South African operations. The evidence is that more stockholders will vote for their "right to know" than for restrictive options.

Advocate groups seek easier mechanisms for individual groups of stockholders to nominate candidates for directors, and the Securities and Exchange Commission may soon act to change standard industrial practice in

this respect.

Advocate groups are also asking that corporations disclose their expenditures for environmental protection or pollution control. Here, for perhaps the first time, the S.E.C. has taken the position that probable environmental problems and expenditures must now be discussed in corporation prospectuses, the legal and public instruments associated with the public acquisition of new capital. A reasonable forecast might be that, when and as other issues of social concern can be demonstrated to have substantial financial impact on

the corporation, the S.E.C. will also require their public disclosure.

A further kind of information disclosure now being discussed is the so-called "social audit." Several groups, including some businessmen, now advocate that a corporation should at intervals commission an objective study of society-related activities, with the results of the study to be made public. The term "social audit" for such an activity obviously draws on the legitimacy of the financial audit performed by certified public accountants, but the questions to be resolved in any "social audit" are not so easily presented as are financial issues. A few firms have attempted such "social audits" in recent annual reports, and some firms in the last several years have been performing, or having performed, what may be called "social audits" for internal consumption.

When and if "social audits," or their kin, become more available, they will supply additional information for investors' use in deciding about buying or selling securities and in voting shares on the various motions at annual meeting time. Yet it is also true that, as an S.E.C. study admits, "Publicly held corporations in the United States have evolved into highly centralized power structures in which the beneficial owners-the shareholders—have relatively little effective control or influence. . . . Corporate managers tend to become self-perpetuating; their ultimate responsibility is to the market place which objectively evaluates corporate performance." The well known "Wall Street rule" is that if you don't like something (management, policies, record, prospects, problems, etc.), then sell the stock. Institutional investors, as the S.E.C. report says, may have the economic power to control or influence corporate affairs, but an S.E.C survey shows that relatively few (34 out of 215) participate in general corporate matters. Even fewer institutions (10) reported their belief that their efforts had "some impact."

Indeed, the impact that the stockholder should have on corporate policy and how stockholder preferences should be measured remain puzzling questions. Especially on social issues, different shareholders may have decidedly different priorities and choices. One answer is to allow the marketplace to sort it out, much as is done now. Another is to ask shareholders by questionnaire to express their priorities on issues of corporate social responsibility. But all this is substantially affected by government, whose regulatory activities often make it a third party in the negotiations between companies and agents such as their stockholders. It was only in 1953, for example, that U.S. corporations were legally recognized as having the right to make charitable contributions with "stockholder money." This was the case of A. P. Smith vs. Barlow, in which the Supreme Court of New Jersey "discarded single-minded reliance on the so-called benefit test and upheld a \$1,500 corporate donation to Princeton University, relying at least in part on business's social responsibility to higher education," in the words of Professor Philip Blumberg in his paper on "Corporate Law and the Social Crisis." Since then, he writes, "judicial decisions involving charitable contributions have uniformly held in favor of the corporation power to act." He goes on to make the further interesting argument that, "... in light of current political realities, it is difficult to imagine the

Internal Revenue Service challenging the deductibility,

as ordinary and necessary business expenses, of corporate social expenditures. Therefore, tax policy concerning the deductibility of corporate social expenditures may ultimately come also to control the question of validity under corporate law."

Corporate social responsibility, which can be thought of as the concern for the impact of all a corporation's activities on the total welfare of society, is constrained, elaborated, interpreted, and negotiated by many agents in modern western society. The investor is one, but only one, of these agents, and corporate management, also one of the agents, essentially conducts the negotiations.

Corporate social responsibility, as an integral element in the corporation's strategy, is seen by enough investors as an important factor in a corporation's success, chance for survival, or latent risk-and in fact is such a factor, along with the health of the corporate sector generally-that the two elements of corporate social responsibility and the investor's interest must be seen as closely and positively related. The question is simply how high is the priority which stockholders and corporations assign to issues of social responsibility in relation to all the other factors upon which depend corporate survival and prosperity.

Edward H. Bowman studied management at M.I.T. (S.B. 1946), the University of Pennsylvania (M.B.A. 1949), and Ohio State University (Ph.D. 1954); he first joined its faculty when the Sloan School of Management was founded at M.I.T. in 1952. He teaches corporate strategy at the Sloan School and has served—on leaves of absence and during a brief departure from the faculty-as Assistant to the President of Honeywell Computer Division, Comptroller of Yale University, and Chairman of the Executive Committee of Dictaphone Corp. This article is an edited and abridged version of a paper published in the Winter 1973 ("Social Responsibility of Business") issue of the *Journal of Contemporary Business* (University of Washington). The complete Sloan School working paper is available from the auMaking urban transportation compatible with an area's goals requires that a single institution have the primary power to both plan programs and implement them. Most often, this institution should be metropolitan; in a few cases, it should be within the state government.

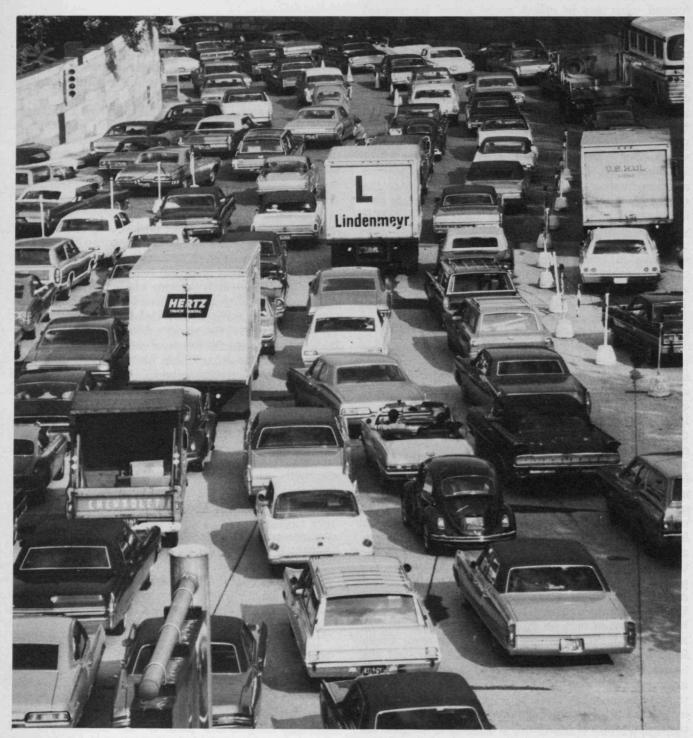


Photo: A. Devaney, Inc., N. Y.

Institutions for Urban Transportation

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With the recent impressive growth of both federal and state funding, and the prospect of large transit programs in our metropolitan areas without a major bloodletting over the property tax, we now are confronted, for the first time nationally, with the problem of untangling the complicated institutional web that plans and operates the transportation systems in our cities. We must now face the question of who should have the power to make decisions.

Comprehensive urban transportation planning as a part of general metropolitan planning has been explicitly required by federal law since the Federal Aid Highway Act of 1962. It has been reinforced by numerous legislative requirements ever since, most notably by the Demonstration Cities and Metropolitan Development Act of 1966, which established the A-95 review procedure required by the Bureau of the Budget Circu-

lar of that number.

These federal requirements, and in some instances certain state statutes, have had significant institutional effects at the state and local level. They have succeeded in getting highway, transit, and urban planners into the same room for the first time, they have forced the combining of highway and transit plans, and they have resulted in the first public debates of these broader issues in many urban areas.

But it would still be hard to generate much enthusiasm for the accomplishments of these federal requirements at the local level. The most important reason for this has been unbalanced, earmarked financing. Another reason is certainly the inherent difficulty within the American political system of accomplishing "comprehensive planning." A third is the inadequacy of the

local institutional structure.

Is Comprehensive Planning Feasible?

The term "comprehensive" suggests not only all-encompassing substance but also long-range timing. The difficulties of considering everything at once and also of predicting needs (as well as desires) over the long term are obvious. No one could deny that both objectives defy man's best efforts, and many sophisticated discussions of this subject have appeared in print. The difficulties have led some to argue that comprehensive planning is an ephemeral hope and that we should lower our sights.

I have difficulty accepting that view, particularly looking at comprehensive planning from the vantage point of transportation planning. We are faced with the

fact that for major transportation facilities, whether they be highways or rail transit, the lead time from initial planning to actual completion of construction is very long. Ten to fifteen years is not unusual. The only alternative to planning such facilities in accord with broad goals—i.e. a comprehensive plan—is to plan them according to simplistic transportation goals. In fact, this is in large part just what we have done.

The "broad goals" must be recognized for what they are; and doing so provides us with a middle path. The institutions that conduct comprehensive planning and implement the programs which evolve from such planning must be highly sensitive to changes in viewpoint and attitude in the community, which can and should produce changes in the plans. And the programs must be staged in such a way that they lend themselves to shifts in attitude among the public and policymakers which result in shifts in goals. Our institutions must not be structured in such a way that broad community opinion is not heard because of a narrowness of access or a remoteness of geography or hierarchy.

When program agencies have a single function, when they are distributed among several levels of government, receiving their funding from different revenue sources in different locations, and when the only bodies which encompass all of them are frequently weaker in political influence and even professional skills than the program agencies they are presumably coordinating and making policy for, then achieving comprehensive planning and, more important, a high degree of sensitivity to changing community attitudes and opinions, is almost beyond hope. In most of our states and urban areas, that is still the situation, despite the progress

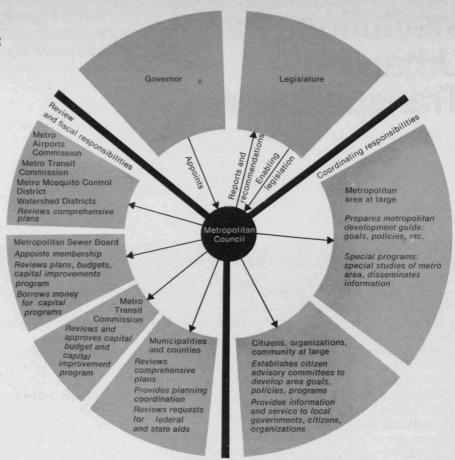
made under the stimulation of federal statutes.

In many areas, whatever the priorities established in a master plan, there is no effective means of enforcing such priorities. The actual planning and construction of highway and transit projects is performed by separate operating agencies on the basis of political feasibility, the agency's funding capacity, and technical judgment. No metropolitan body reviews these decisions and enforces priorities. Priorities may change over time, but it seems reasonable to insist that these changes should be made by the agency responsible for the original plan, not by operating agencies on their own.

Assigning the Responsibilities

What agency can best perform the functions of setting the priorities of a comprehensive plan, of issuing the

An organization chart for the Metropolitan Council created by the Minnesota State Legislature in 1967 "to coordinate planning and development" in the seven counties of the Twin Cities, Minneapolis and St. Paul. The Council requires communities and counties to submit long-range land use plans, and it has some authority to stop implementation of such plans if they conflict with metropolitan planning.



directives to program agencies to proceed with project plans and implementation, and of altering the priorities and indeed the projects to meet changing conditions? These functions are now widely distributed. They should be centralized since they are all part of the long-

range planning process.

To illustrate this point, let us assume that a metropolitan region has agreed on the long-range fundamental objectives of establishing a strong center and strong sub-centers as an alternative to sprawl. A comprehensive plan calls for major and high-priority investments in fixed rail transit as one means of achieving this objective. Let us assume further that insufficient funding is available for such transit lines but substantial funding is available for new freeways on the periphery of the metropolitan area. Under typical political conditions, the transit program would have to either await the development of new state and federal funding or go to the voters for local funding from the property tax or a local sales tax.

But nothing would stop the construction of the new highways. Since the fringe municipalities would probably favor the roads, no political opposition would come from that quarter. Only opposition from the metropolitan planning agency and perhaps from the inner-area municipalities might be expected. The agency responsible for highways would ordinarily want to "get on with the job" since its "success" is generally measured by new roads constructed.

The construction of the peripheral highways would be exactly counter to the objective of the master plan, even though it would be consistent with the objectives of the state highway agency (which provides the dollars) and the peripheral local governments in whose jurisdictions the roads would be located. It is therefore clear that the agency which approves the master plan must also be the agency which determines project decisions.

Which agency shall this be? The answer should hinge on evaluation of the present and potential capabilities of the candidate agencies, including political muscle, technical competence, and representativeness. At present, these capabilities are widely distributed among agencies, and they are distributed in differing ways; in particular, the distribution between state and local agencies varies considerably from place to place. This suggests the need for flexibility in seeking solutions to the decision-making problem. Differing state-local political traditions militate against a simplistic, conforming solution for all urban areas.

Two major institutional trends in recent years have moved us closer to having capable metropolitan transportation decision-makers. The first is the trend toward Departments of Transportation (D.O.T.) at the state level. The second is the rapid growth of "Councils of Government" (C.O.G.) in our large urban areas, which are usually combined with, or closely related to, metropolitan planning agencies. While C.O.G.s range over policies far broader than transportation, their creation was stimulated by federal transportation legislation and

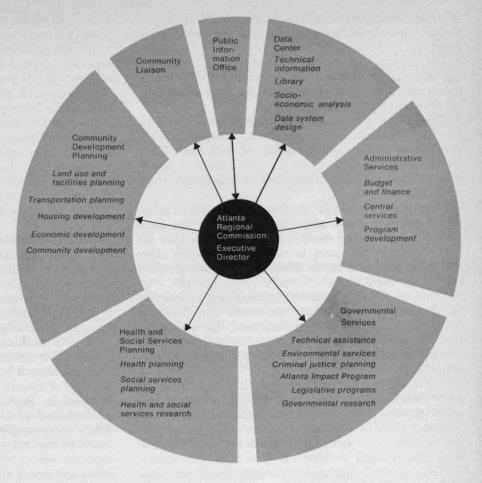
local transportation problems.

The D.O.T. movement has several objectives.

-A D.O.T. is intended to give to a state a comprehensive capability in the transportation field, urban and interurban, private and public. It significantly broadens a state's responsibilities, which have traditionally been only roads and regulation of common carriers.

—The establishment of a D.O.T. opens the door to

An organization chart for the Atlanta Regional Commission, established by the Georgia Legislature in 1971. It has the authority formerly vested in the Atlanta Regional Metropolitan Planning Commission, the Metropolitan Atlanta Council of Local Governments, the Metropolitan Atlanta Council for Health, and the Atlanta Area Transit Study. Though the Commission does not consider itself to be a council of government, it has similar functions.



enhancing the powers of a state's chief executive over highways—a program which in most states has been qausi-autonomous. If the Governor's powers over the highway program are increased, there is a greater likelihood that other values besides narrow highway objectives will be allowed to influence the highway program. The highway program is likely to be less exclusively responsive to narrow highway interest groups than has

been the case in the past.

The C.O.G. movement, now nearly universal in large urban areas, is a second best response to the widelyperceived need for metropolitan government in the U.S. Its accomplishments have been modest, largely because it is almost wholly dependent on concensus for its authority. Yet the very presence of C.O.G.s, and the federal legislation that stimulated their development, have forced metropolitan areas to do some thinking about goals and objectives. The C.O.G. provides a forum for discussing goals, and long-term transportation programs aimed at meeting them. The C.O.G.s have identified problems that require metropolitan solutions. They have generally built up competent planning staffs. What C.O.G.s have been unable to do, because of their limited authority, is to require municipalities to make decisions consistent with the C.O.G.'s plans.

The objective of unifying decision-making can be met, in theory, either by strengthening the C.O.G., or by transferring powers to the state. Either of these will have to be done by the state. In some states the first solution appears to be best; in others, the second.

Strengthening Councils of Government

Let us first consider the alternative of the strengthened C.O.G. While nearly everyone asserts that "metropoli-

tan decision making" is important, there are few local governments—that is, local politicians—that are willing to give up really significant powers. Most of what little metropolitan decision making we now have has resulted from carrots-and-sticks tactics emanating from Washington, D.C. In general, the states have played a passive role; they have willingly created metropolitan institutions when demanded by local leadership or referendum. But they have never to my knowledge required the establishment of such institutions over the opposition of local political leaders—as was done by Ontario in the Toronto area.

There are ways, however, in which states can use their substantial urban transportation funding to encourage the strengthening of metropolitan institutions. As we have already suggested, the present methods of funding transportation programs in urban areas tend, in fact, to undermine these institutions. But, with the growth of state financial assistance to transit (in combination with federal aid), it becomes increasingly possible for states to offer to their major metropolitan areas the option of block transportation grants as opposed to the present approaches of functional grants or categorical project funding, with the decision-making power residing in the state in the latter case.

The block transportation grant, is feasible only if two

factors are present:

-The funds, regardless of their source, must be available for whatever uses the urban area chooses, in ac-

cord with its own priorities, and

—The urban area must in fact be able to make its own decisions. Thus the responsibilities of the state are, first, to provide sufficient and flexible funding so that block transportation grants are feasible, and second, to require an adequate delegation of responsibility by the jurisdictions of the area to their Councils of Govern-

The approach of strengthening the C.O.G. and moving most major transportation decision-making to the urban area is the preferable option for most of the larg-

est urban areas, for these reasons:

—The federal government has already moved a long way in this direction. In its proposed Federal-Aid Highway and Mass Transportation Acts of 1972 and 1973, it recommended a single fund for urban areas if appropriate "consortia" are established to administer these funds locally.

-Most of our largest urban areas are located in states which either contain other large cities, or are more rural than urban; the result is either a tendency for the major metropolitan areas to compete with each other for state largesse, or a dominant anti-urban ethos

throughout the state.

—Given the difficulty inherent in achieving a consensus on meaningful metropolitan goals and the likelihood that such goals will change over time, one can argue that elected officials are likely to be better "tuned in" to current and changing public attitudes than are state officials.

-C.O.G.s are better suited to relate transportation to other metropolitan issues, such as environmental and social questions, than are state transportation agencies. -Giving C.O.G.s a stronger role in urban transportation should have the effects of forcing them to consider other related problems, such as land-use controls.

While allowing metropolitan areas to make their own transportation decisions may be sufficient to encourage improvement of metropolitan decision-making capability, it must be recognized that such a "carrot" will not always succeed in its objective. There may well be areas where a local government will prefer state authority to C.O.G. authority. C.O.G.'s are not infrequently viewed as weak, dominated by particular members (representing either a suburb or the central city), as biased toward particular policy solutions (for example, mass transit). Whether such opinions are justified as beside the point; if they are strong enough, they can make the carrot unattractive. In these instances, certain measures may be necessary to accomplish the objective. For example, the state might make the strengthening of the C.O.G. more attractive by offering more money than would otherwise be available.

No states have yet required by legislation the establishment of strong metropolitan institutions. There are, however, two examples of states which have authorized stronger metropolitan institutions for transportation planning and decision-making than those prevailing elsewhere; these are California and Minnesota, for the

Bay Area and the Twin cities respectively.

For the San Francisco Bay area, California established the Metropolitan Transportation Commission (M.T.C.) in 1970. This representative body has significant powers over both planning and project decisions, and through a memorandum of agreement, it has tied itself closely to the region's C.O.G., the Association of Bay Area Governments (A.B.A.G.). It is not the perfect theoretical solution—which would be to give these powers to A.B.A.G.—but it appears to be a workable compromise.

For the Twin Cities area (Minneapolis-St. Paul), the

Minnesota legislature in 1967 created the Twin Cities Metropolitan Council, which is not a C.O.G. in the usual sense. Its members are appointed by the Governor to represent defined districts of the metropolitan area. No elected officials may serve on the Council. The Council may review all plans of regional operating agencies, such as the Metropolitan Transit Commission, to determine whether these plans are consistent with metropolitan-wide planning. If it determines otherwise, and if no satisfactory agreement can be reached with the operating agency, the matter is referred to the state legislature for resolution. The Council also has taxing powers, and has more or less direct authority over the Metropolitan Sewer Board.

Strengthening State Powers

The second general approach available to states and urban areas to achieve unified decision-making is to raise all the key decisions to the state level. This has begun to happen in a number of Eastern states, and has certain desirable attributes under some circumstances. It is most fully developed in Maryland, but the trend is evident in Massachusetts, New Jersey, New York and several other smaller states.

Maryland and Massachusetts are both states in which a single dominant metropolitan area is entirely within its borders. Boston, the core city of Massachusetts' metropolitan area, happens to be the state capital. While not formally the state capital, Baltimore houses much of the Maryland state bureaucracy and, in any event, is only a short distance from Annapolis. Both states are among the most urban in the nation; in both, the major metropolitan area represents about half the population of the state. Under such circumstances, something like a city-state is developing and will clearly continue to do so.

In Maryland, the state D.O.T. has available to it a trust fund for all modes of transportation, in fact, it is the owner and operator of the Baltimore transit system. There is no longer a separate highway commission. Massachusetts has not achieved such a high degree of centralization, but the Boston-area transit system (the Massachusetts Bay Transit Authority) is a state agency, as are the Massachusetts Port Authority, which operates the sea and airports and a bridge, the Turnpike Authority, which operates the toll-road and two tunnels, and the Metropolitan District Commission, which operates, among other things, a number of major scenic highways. At present, all of these agencies are somewnat loosely related to the state's Secretary of Transportation and Construction; each continues to have its own board appointed by the governor.

Both New Jersey and Connecticut are also moving toward a stronger state role in transportation and planning, but here the logic seems to be the opposite of that in Massachusetts and Maryland. Though they are highly urban states, neither New Jersey nor Connecticut has a dominant city; both states contain large suburban areas attached to out-of-state centers, as well as numerous smaller urban areas. Thus, with urbanization and fractionated government, only the state has the capacity to direct major urban programs like transporta-

The major deficiencies facing states as they consider more active involvement in urban transportation decision-making are these:

—Few states have moved very far toward meaningful state-wide "comprehensive" planning. As a result, state transportation plans and programs seem likely to continue to be functionally oriented rather than based upon broader state or urban area objectives.

—The diversity of state programs in urban areas is less than that of municipal government activities. Thus the natural official spokesmen for urban interests are not typically found at the state level, but rather in local

government.

—Many states are sorely lacking in the kinds of technical skills needed for broad-based comprehensive planning; such skills are more commonly found in metropolitan planning agencies and in big city bureaucracies. Most states' transportation capability remains heavily highway-oriented. This is changing in some places, but in many states urbanites strongly distrust their D.O.T.s, considering them to be hand-maidens of the highway lobbies.

—In most states, the governor lacks sufficient powers to assure coordinated planning and programs; the prevailing state tradition continues to be functional autonomy rather than executive centralization.

—No states have any effective power over land use in urban areas. Indeed, the thought of states assuming such powers would be considered very radical indeed

in many states.

Most of the states we have mentioned are ones in which governors have increased their powers considerably in recent years. There is no doubt that increasing state decision-making power is workable or desirable only where that is the case. The governor, in states such as those mentioned, is the only "chief executive" the metropolitan areas have; thus it can be argued that he is representative. If he has gained control over the formerly autonomous (and often legislatively controlled) highway agency and has transformed it into a multimodal D.O.T. answerable primarily to him, then he has demonstrated the needed political muscle. With reorganization, he may also have asserted stronger controls over other state agencies, and should thus be able to draw on whatever technical skills may be available there to evaluate transportation programs with respect to their non-engineering impacts. Furthermore, there is conclusive evidence that urban state governors have recently greatly expanded the planning and managerial capability of their own immediate offices to assure greater coordination of programs.

We have argued that effective coordination of urban

transportation programs with the goals of metropolitan areas requires that comprehensive institutions must exist both for long-range planning and the implementation of plans. The enforcement of agreed-upon priorities in a page tiel alternate of the process.

ties is an essential element of the process.

We have further argued that both kinds of decisions must be made by the same institution, and that to be effective, that institution must have "political muscle" the requisite technical skills, and legitimacy (that is, it must be representative). The latter is particularly important because of the problems inherent in long-range planning in U.S. metropolitan areas; the body which makes the plans and sets the priorities must be capable of sensing changes in public attitude requiring revision of plans and programs.

From the importance of this last point, it can be concluded that in most places, the most desirable path is to strengthen the present Councils of Government so that they have sufficient authority to enforce their transportation plans and decisions. With only limited exceptions, states should delegate their own present decision-making power on highways to the C.O.G.s, but conditional on the latter's capability to act. Any action to strengthen the C.O.G.s will have to come from the

state

While for most urban areas this appears to be the best solution, there are a few places—mostly small, highly urbanized states with no more than one major metropolitan area—where the state can do a better job than the C.O.G. and meets the legitimacy requirement reasonably well. In these places, the elaborate trappings of metropolitanism may be not only unnecessary but competitive and unworkable.

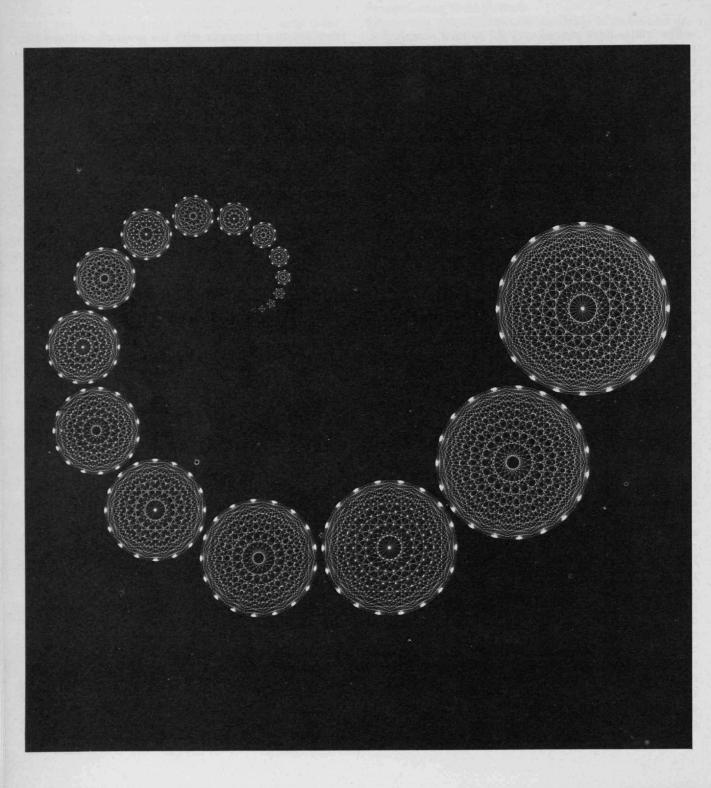
Most of our states and their urban areas are at a crossroad on these decisions. Both the D.O.T. and the C.O.G. movements are well advanced. It is hoped that the values to be derived from each are well understood and do not lead to competition for the power to make

key urban transportation decisions.

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Every year since 1963 Edmund C. Berkeley's magazine, Computers and Automation (and People) has conducted a computer art contest—now called an exposition, to remove the stigma of competition. This work, entitled Archimedean Spiral, was planned by Norton Starr of the Mathematics Department, Amherst College, and produced at the University of Waterloo (Ontario) Computing Centre using a Calcomp 30-in. drum plotter from

instructions prepared on an I.B.M. 360-75. Further details for those of our readers who are interested, as described by the author: The center of each individual network is on the Archimedean spiral $r=\theta.$ The triangle (smallest figure) is centered at x=y=0, the largest network at $x=2\pi,\,y=0.$ Each network is the complete graph on n vertices, where n runs from 3 through 20, inclusive. (Photo: $Computers\ and\ Automation)$



Trend Affairs

Trends This Month

PERSPECTIVES

The Club of Rome seeks new definitions of limits to growth, while themselves remaining non-defined . . . Why doctors and engineers sometimes decollaborate . . . Latin American development is an international project ... Holography preserves the past.

ENERGY

Oil is our Achilles heel; turn to nuclear fission and synthetic oil from coal . . . but we must not forget that in times of want one must tighten one's belt . . . and utilize the less convenient resources . . . while we ponder the management of fusion research.

EARTH AND SPACE

Solid evidence for continental drift has been lifted from the sea floor . . . and scientists anticipate information from the not-so-solid (maybe) tail of Kahoutek's Comet.

SCIENCE POLICY

Can the N.S.F. really replace the Presidential Science Adviser? . . . with the aid of a completely revamped science policy, perhaps.

TRANSPORTATION

Unpredictable commuters take mass transit for a ride . . . The S.S.T.'s faster speed does not necessarily mean economies of scale.

PERSPECTIVES

The Problem Is the Problematique

The problem is the problematique, says Aurelio Peccei, Italian industrialist who founded the Club of Rome and is Chairman and President of Italconsult.

By that word, he writes in the June issue of Simulation, the members of the Club of Rome mean the "cluster of intertwined problems" which together produce "world-wide symptoms of a general but as yet little understood malaise."

Among the symptoms are those familiar to all of us: deterioration of the environment, the "crisis of institutions," uncontrolled urban spread, insecurity of employment and the loss of satisfaction in work, alienation of youth, violence and disregard of law and order, "educational irrelevance," inflation and monetary disruption . . .

Sensing their inability to understand the interrelations of these issues, the members of the Club of Rome resolved two years ago to encourage Jay W. Forrester, Professor of Management at M.I.T., to undertake his "world dynamics" model (see "Counterintuitive Behavior of Social Systems" by Jay W. Forrester, January, 1971, pp. 52-68). But that project, says Mr. Peccei, was only the beginning, "a first hesitant step towards a new understanding of

Here are some of the next stages which the Club of Rome envisions in the search for an understanding of the

problematique:

-Refining, modifying, or discrediting the world model used by Professor Forrester and his colleagues, including especially Professor Dennis L. Meadows who was the principal author of The Limits to Growth; Mr. Peccei expects this to be "an unending" activity, though a good many of the critics of the study "are in fact criticizing what the study did not set out to do."

—Disaggregations of the Forrester-

Meadows work-studies confined to particular regions or aspects of the world model.

—A "strategy for survival" project at Case Western Reserve University, which seeks to use computer models to suggest specific actions which might respond to specific problems.

-A "world model" as seen from the point of view of the developing countries, a project known as "the first alternative world model," now being undertaken by a team of Latin Ameri-

—Studies of world population growth the issue which, says Mr. Peccei, appears to members of the Club of Rome "to be at the center of gravity of the problematique."

-Long-term research on the "concept of an equilibrium state of no-growth." That concept now raises images of "inertia, decay, and boredom," writes Mr. Peccei, but one can also postulate "various types of dynamic equilibrium . . . which would make possible social, cultural, and quality developments . . . (and) which might well permit desirable and sustained growth, tolerable within planetary limitations and free from the undesirable features of our present economy of consumption and waste."

-A "fundamental reassessment" of the place of science and technology and the promise they offer for the future; this would include "new methodologies of long-term scientific planning in an economic and social

perspective."

The effects of "huge urban con-. glomerations" as "major agents of dis-ruption and chaos" because of the little-understood psychological effects of overcrowding and proximity—"the lemming syndrome," Mr. Peccei calls

-Studies of social elements, symptoms, and indicators so that these factors can be included in future world

-Institutions and policymaking appropriate to the scale and depth of the problematique, and the political consequences of analyses such as The Limits to Growth.

What is the Club of Rome, and what should it be in relation to these issues? It must not become a group of advocates, and it cannot become a large organization for research sponsorship, think Mr. Peccei and the Club's Executive Committee. It must remain a nonorganization, exemplary of the fact that man "is presumably the only planetary species aware of his own predica-ment." Though man has "the potential of self-development," writes Mr. Peccei, "the very forces in his nature which have raised him above the animals weigh against deliberate self-evolution.' To resolve these by focussing attention on them is no small purpose.—J.M.

The Doctor's World Is Not the Engineer's

Can engineers and doctors learn to work together?

The issue is not entirely simple, thinks Robert W. Mann, Professor of Engineering at M.I.T. who directs a major research program in biomaterials funded by the National Heart and Lung Insti-

The problem stems from differences in the nature of medicine and engineering and in the conditions under which doctors and engineers work, Professor Mann told members of the American Society for Artificial Internal Organs as the guest lecturer at their annual meet-

ing in Boston last spring.

To be effective in diagnosing and treating patients, physicians must have "a vast array of information, largely qualitative and unstructured, describing the normal and pathological state of man," a kind of mental handbook of facts and interrelationships. In contrast, said Professor Mann, the engineer's physical reality "conforms to a quite limited set of very general principles, . . . the physical and chemical laws of nature and the mathematics through which they are described and manipulated."

Another difference: physicians must be responsible for their patients on a moment-to-moment basis; they cannot sit back while the patient's strength ebbs, hoping that the crisis can be postponed until the malady is better understood. In contrast, scientists and engineers are used to choosing their problems "carefully and deliberately," said Professor Mann; they work on "time scales totally different from those

of the physician."

Progress in artificial organs depends on close collaboration between physician and engineer; each must to some extent submerge his preferences and traditions to understand the other's.

And it can be done, thinks Professor Mann; collaboration between engineers and doctors-though in its infancy-"already productive and promises extraordinary human and benefit."-J.M.

Is Synergy Possible in the Americas?

It is too early to know what, if anything, last summer's Science and Man in the Americas conference in Mexico City has accomplished toward inter-American scientific and technical coop-

The first-of-its-kind conference, cosponsored by the American Association for the Advancement of Science (A.A.A.S.) and Mexico's National Council of Science and Technology (C.O.N.A.C.Y.T.); had the grandiose goal of "future development and wellbeing of the Western Hemisphere." No one, of course, expected the two-week meeting to achieve a whole lot in that direction. It was hoped that some new starts would be made in a new communicative and cooperative spirit.

The conference organizers seemed to view national development in Latin America as an international endeavor, not the kind that some participants denounced in which a senior "partner" plants some of his technology in the junior "partner's" soil and reaps most

of the benefits.

It was evident at the meeting—as it is in the increasingly bold actions of the Middle Eastern and North African oil-producers—that the developing nations are aiming toward greater technological as well as economic independence. They continue to want assistance, but no longer on terms that

stunt their growth.

The desire for increased independence on the part of the developing nations is coupled with an increased dependence on the part of industrial nations and international companies on the cheap labor, financial favors, and markets of the developing countries. Several speakers viewed this desire as an opportunity that could lead-albeit along tortuous and painful pathwaysto better balanced political and economic interactions between nations. In terms of petroleum policy, a non-hemispheric guest, Jean C. Leclercq of the Commission of the European Communities, told a conference audience:

"Economic and social cooperation would establish between the Community and its suppliers a climate of mutual trust, which, in turn, would be the best guarantee of the stability . . .

The breadth of topics at the conference was remarkable: 40 symposia covering such areas as transfer of technology, nutrition and food technology, earthquake engineering, hurricane forecasting and control, deserts and arid lands and their development, the sea and its resources, educational technology, population problems, science and development and human values, ecology and environmental deterioration, violence and behavior, health services, and human dwellings.

Several symposia, especially the fourday Technology Transfer session, generated considerable heat-some of it ideological and some intellectual gameplaying-but most of the controversy was in the form of rational differences in approach that arise naturally out of heterogeneous backgrounds. It was probably the most successful session in

sheer communication.

Managerial Cross-Currents

The otherwise smoothly run conference was marred by subsurface management bickering. "Bad feelings between Mexican and U.S. organizers became so intense," according to a A.A.A.S. official, "that it would be impossible for the same people to work together again."

The A.A.A.S.'s public information apparatus—one of the most proficient in conference coverage-was uncharacteristically lackadaisical in its North American promotion of the Mexico meeting. As a result, less than 20 U.S. and Canadian reporters attended (A.A.A.S. meetings normally attract hundreds of science writers) and media coverage was a flop. This was especially disappointing—the A.A.A.S. has a large program in public understanding of science and this meeting was an attempted new departure in international science and technology relations-it thus deserved intensive coverage.

Nevertheless, the conference came off. It drew 5000 registered participants. And it did establish some dialogue toward cooperative development in the Western Hemisphere; not necessarily government-to-government, but between individuals who work for governments, universities, and industry.

Conference Co-chairman Gerardo Bueno Zirion-Director General of C.O.N.A.C.Y.T., an agency that organizes and coordinates development projects in Mexico and other Latin American countries—said the meeting was meant to help nations toward identifying workable goals. Until this is done and a mechanism to evaluate proposals exists, any plans to modernize Latin America will be of doubtful

Glenn T. Seaborg, the U.S. Conference Co-chairman and Chairman of the Board of the A.A.A.S., is pushing hard for an affiliation with existing similar associations in Argentina, Brazil, Colombia, Peru, and Venezuela. He would have such an organization dedicate itself to the advancement of science and technology in the hemisphere. Indeed, as proposed in his long article in the journal Science (July 6) which was distributed at the conference, Dr. Seaborg would pull together all of the world's 40 or so such national associations. This could indeed be a step toward Director General Bueno's prerequisites for Latin American development.—R.S.

Can Technology Save a Heritage?

The gradual erosion of Italy's historic statuary, much of it outdoors, is just one more item on a long list of problems caused by industrial and urban pollution. But this problem is finally beginning to receive attention.

Techniques developed by Dr. Ralph Weurker of the TRW Systems Group, proved in a series of experiments conducted in Venice, Italy, the feasibility of making full-size, three-dimensional reproductions of statuary by the tech-

nique of laser holography.

A hologram is a recording on photographic film of the blending of two beams of laser light—a reference beam and a beam reflected from a physical object in space. The two beams interfere with each other; the resulting interference fringes are recorded on the film. The film shows no visible image, only dusty swirls of gray-silver emul-sion—the hologram. But its silver grains contain all the information required to reconstruct an image of the object. If laser light is shone through the hologram, the silver grains break up the light just as the object did when the hologram was first recorded. In effect, the image is "played back" and appears in space. The image has depth and parallax; that is, viewers can see hidden surfaces by moving their heads to one side. In the words of Dr. Weurker, "the hologram is the most realistic image achieved to date. . . . Under proper conditions, a person can be completely fooled. He will not know that what he sees is phoney."

Dr. Weurker explains the potential application of holography for the preservation of artistic masterpieces: "Art treasures can in the future be shared beyond the bounds of individual museum or church displays when technology develops an acceptable means of presentation. In the present state of the art, a three-dimensional full-size hologram of a sculpture is so true to life that visitors will not realize it is not an original unless they attempt to touch

it."

The TRW laser, a pulsed ruby of 0.6943 microns wavelength, beamed its light to perform other experiments. It recorded minute dimensional changes



Can technology save a heritage? It may be possible by using laser holography to record and display Italian artistic treasures, as in this photograph of a

hologram of Donatello's S. Giovanni Battista. The full-size, three-dimensional reproduction is said to be virtually indistinguishable from the original.

on wooden statuary caused by temperature and humidity changes. The holograms showed blisters and fissures measuring only five-millionths of an inch; it revealed patches made hundreds of years ago on sculpture that was even older. When Dr. Weurker's team focussed the laser beam directly onto pollution-blackened marble statuary, they found the laser could clean with precision. The laser beam loosened and removed external calcium sulphate pollution without affecting the marble underneath.

The "Venice expedition", as it was called, was requested by Dr. Giovanni Urbani of Rome's Instituto Centrale del Restauro. The project might be a first step leading to a government program of holographic recording of valued art

Is that likely? Unfortunately, says Dr. Weurker, the experiments conducted in Venice are just that—experiments. Without more support he doesn't think they will lead to practical techniques for art preservation. But if nothing else, he says, they have helped technologists "to see the importance in the transfer of aerospace science and technology to the arts. This was an exciting project. Unfortunately, the arts never have the budget of the Defense Department."-Michael Chiusano

Prescription for an **Energy Emergency**

The U.S. is in the midst of a "national energy emergency," and our best chances of relief lie in reducing our reliance on petroleum by developing coal and nuclear fission as near-term (1985) future energy resources.

In the case of coal, Carroll L. Wilson, Professor of Management at M.I.T., calls for "a massive crash program" of research to identify the best process (es) by which to produce "a clean, all-purpose and readily transportable gaseous fuel." He also proposes synthetic oil industries based on coal to help decrease U.S. dependence on imported petroleum.

Though coal gasification has been demonstrated, Professor Wilson, writing in the summer issue of Foreign Affairs, admits that "technological obstacles to producing gas of pipeline quality from coal are still formidable"; hence his emphasis on simultaneous development of pilot and demonstration

plants.

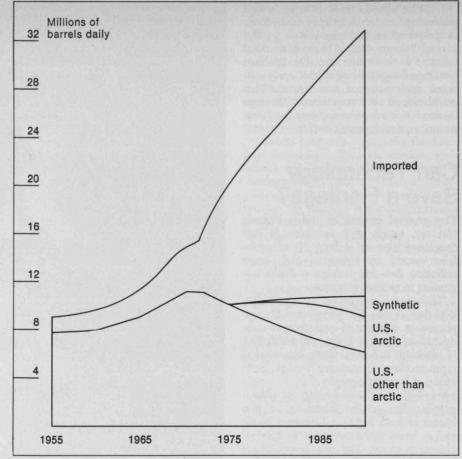
In the case of nuclear fission, Professor Wilson, who was the first General Manager of the new Atomic Energy Commission when it was founded in 1946, admits that the simple dream which he and many others then shared —that fission could, "without undue difficulty, become the most important source of energy we have, especially for electricity"-is fading. "Problems have mounted, and delays, restrictions, and technical uncertainties have dogged nearly every one of the many steps needed to bring a new nuclear plant into full operation.

Yet meeting these problems seems to Professor Wilson both urgent and simple: put all new nuclear plants underground, "in suitably impermeable geological formations." He believes this would be an "entirely practicable course of action," adding only "a small fraction to their cost," that would reduce the environmental impacts of plants located near population centers, where energy demand is highest, and provide safety from the effects of a

nuclear accident.

The central focus of Professor Wilson's proposals is to reduce oil consumption to some 30 per cent of total U.S. energy-fuel use by 1985. Thus oil supplies would be sufficient for transportation-and oil would be limited to that use, where other fuels are far less practical.

The point is to modify the "enormous foreign-exchange drain" and the "perils of open-ended dependence" countries of the Middle East which is now implied by ever-increasing U.S.



The keystone of a 10-year program responding to America's "national energy emergency" proposed by Carroll L. Wilson, Professor of Management at M.I.T., is to reduce the country's dependence on petroleum as an energy source. "Although we will have to live through a period of substantial reliance on Middle East oil," writes Professor Wilson in the summer issue of Foreign Affairs, "it is

hardly an acceptable national policy to leave the emerging situation in this highly unsatisfactory state. There are simply too many cumulative problems and dangers involved." The chart shows present predictions of U.S. petroleum consumption and sources; Professor Wilson's goal is to hold consumption to a 43 per cent increase by 1985. (Data: Shell Oil Co.)

petroleum imports.

Already Professor Wilson thinks that excessive U.S. energy consumption is "a potential disruptive force in almost every market." Unless we help contribute to a more equitable balance of world energy supplies and consumption during the rest of the 20th century, thinks Professor Wilson, "there is scant hope for human progress and peace in the long run."—J.M.

To Put Our Energy House in Order

If the U.S. does in fact confront a "national energy emergency" (see above), how shall it marshal resources to solve its problems and avoid disaster in the future?

Writing in Foreign Affairs this summer, Carroll L. Wilson, Professor of Management at M.I.T., says the answer is a new National Energy Authority

"with appropriate powers to . . . override" on land acquisition, siting, and environmental problems. It would include a National Energy Finance Corp. to underwrite energy facilities which are urgently needed but could not be financed privately, and it would be prepared to "undertake extensive research and development and pilot plant and demonstration operations.

Professor Wilson's goal: to keep energy costs for "premium fuels such as gas or oil" below \$1 per million B.t.u. in 1985, equivalent to oil at \$6 (1973) per barrel or gas at \$1 per thousand cu. ft. This is roughly twice present prices, and it is the most optimistic forecast which Professor Wilson

believes can be achieved.

Its achievement in fact will depend on extending our use of coal and nuclear fission, on limiting our use of petroleum and gas (see above), and on energy conservation which reduces the annual growth rate of U.S. energy consumption from today's 4.5 per cent

to 3 per cent; this would reduce 1985 energy consumption from 70 per cent to only 43 per cent more than in 1972.

After decades of "extravagant and wasteful use of energy," writes Pro-fessor Wilson, it's more than time for the U.S. "to hitch up its belt and put its energy house in order." This is a matter of economic self-interest, and it also would contribute "an essential ingredient in a new approach to the energy situation by the whole international community."—J.M.

To Have More Energy, Save More

Can the U.S. improve its energy supply

and reduce energy costs by plugging leaks in its energy consumption system?

The answer, of course, is "yes." And Charles A. Berg, Deputy Director of Engineering at the Bureau of Standard Charles A. Berg, Deputy Director of Engineering at the Bureau of Standard Charles T. The Standard Charles T. The bureau of S dards' Institute for Applied Technology, gives some interesting examples in a paper in Science (Vol. 181, July 13, 1973, pp. 128-138).

But there is more to the matter than just saving energy, warns Dr. Berg. Reductions in energy use should not be at the expense of our ability to produce more energy more efficiently (for example, curtailing industrial electrolytic processing would save energy but could adversely affect the energy supply by causing shortages of electrical conductor materials); and short-term economies are not economies if they lead us to consume fuels now with less efficiency than we are likely to be able to attain in the future.

Given these constraints, Dr. Berg proposes a series of potential economies

for careful study:

-Eighteen per cent of U.S. fuel consumption is now devoted to space heating and cooling. Perhaps half of that energy could be saved if all buildings were insulated to reduce heat losses to 700 B.t.u./1,000 ft.2/degree-day; the present standard for F.H.A. housing loans is 1,000.

-In all, thinks Dr. Berg, "buildings now consume 40 per cent more energy than is necessary"-in inadequate insulation, excessive ventilation, and

wasteful illumination.

-Perhaps 30 per cent of the energy used in industrial processes could be saved by applying familiar techniques "that are economically justifiable at today's fuel prices." Higher fuel prices would increase potential savings.

-Look harder at solar energy. We already know that its use for domestic and commercial hot water might save 1.5 per cent of total national energy requirements, writes Dr. Berg. A solar energy collector to provide domestic hot water might cost an individual

householder about \$76, thinks Dr. Berg; on this basis the U.S. would spend \$4.5 billion to increase the national energy supply by 1.5 per cent. A similar increase through expansion of electrical generation and distribution capacity might cost \$16 billion. Hence Dr. Berg's suggestion that "local utilization of solar energy for low-temperature heat (may ofter) an effective investment opportunity in the context of national energy planning."

Consider incinerators as sources of energy as well as disposers of waste. By 1990, thinks Dr. Berg, "the heating content of collected urban refuse could be used to generate as much as 35,000

mw. of electricity."—J.M.

Consider Trees as **Energy Converters**

A 400-mi.2 "energy plantation"—a forest 20 miles on a side with a woodfired steam power plant at its centerwould be a self-sufficient converter of solar energy to electrical energy at the rate of about 400 Mw./yr. With all the expenses of land ownership, fertilizing, harvesting, and processing considered, the plant's fuel might cost between 70 cents and \$1/million B.t.u., compared with 60, 50, and 30 cents/million B.t.u., respectively, for oil, coal, and gas in

This vision of a cost-effective method of converting solar into electrical energy results from computations by George C. Szego and Clinton C. Kemp, President and Vice President, respectively, of Inter-Technology Though it is grossly inefficient in terms of the amount of available solar energy converted into fuel (somewhere between 0.4 and 0.7 per cent), the "energy plantation" system offers some interesting advantages:

-Capital costs are substantially lower (about \$1,000/kw.) than for any other method now proposed for large-scale

utilization of solar energy.

There are no storage problems, as with other solar energy systems; the trees themselves perform the storage function on cloudy days.

-Vegetable matter-either agricultural crops or pine softwood-contains less than 0.1 per cent sulphur, less than virtually any fossil fuel.

-Long-range ecological implications are minimal; the carbon dioxide released in burning the fuel will be the same amount as was consumed during its growth, and the same "recycling" pattern will apply to the waste heat of combustion.

-The by-product of the combustion process can be directly returned to the land as fertilizer.

The cost figures cited by Messrs.

Szego and Kemp depend on only modest increases in the amount of fuel which can be harvested for a power plant compared with present forestry operations geared to the production of pulpwood. "At solar radiation conversion efficiencies only two to three times those already being achieved fortuitously from forestry-type operations," they write in Chemtech (May, 1973, pp. 275-84), "fuel value probably can be sold on a sound business basis."—J.M.

A. E. C. Mini-funding Fusion Research?

For over a decade the United States has drawn heavily on an active Soviet fusion energy development program as a free source of new ideas. Under the stringencies of a small budget, the Atomic Energy Commission's Con-trolled Thermonuclear Research Division (C.T.R.) has been forced to fund only a few "mainline" programs in their drive toward demonstrating scientific feasibility.

Although the present outlook is optimistic, it became apparent during a recent A.E.C. review that a sizeable number of scientists involved in fusion research feel a certain apprehension. They fear that the U.S. effort may be overlooking significantly less expensive reactor designs by not supporting the study of "exploratory concepts". These are off-beat and poorly understood but scientifically promising ways of attack-

ing the fusion problem.

The C.T.R.'s narrow concentration and reliance on the Soviets carries with it an inherent danger, warned Irvine Rostoker of the University of California at Irvine, especially since the recent death of Lev Andreyevich Artsimovich, the guiding force in the Russian fusion effort. Without an active exploratory concepts program there is no positive mechanism for transferring new technological developments into the fusion program.

Professor Rostoker's critique was part of a presentation to the C.T.R.'s Standing Committee, an advisory group charged with reviewing the current status of fusion research, identifying future problems, and making recom-mendations on funding levels for the

1975 fiscal year.

Although totally unpublicized beyond the required announcement in the Federal Register, the meeting, held at M.I.T. last spring, was open to the public for the first time. Some 40 to 50 interested bystanders, mostly members of the fusion-research community, heard two days of reports on the research program and the Standing Committee's deliberations.

The consensus of the meeting was that research funding should doubled if an adequate underpinning for the continued development of fusion

power is to be assured.

A.E.C.'s fusion division has a backlog of several hundred exploratory research proposals and a niggling 1974 budget of \$200,000 to evaluate them. Recommendations were made to increase the budget to as much as \$4 million in 1975.

Several years ago laser fusion-currently a major alternative for fusion power-was one such proposal. Fortunately for the controlled thermonuclear fusion researchers, the Department of Defense thought that laser fusion might have military potential and so funded A.E.C. research in this area.

Exploratory research is underway into several schemes for plasma heating-including ohmic heating, magnetic compression, and injection of neutral particles. Other concepts of heating that look equally promising are not being developed. Yet heating is one of the major problems that must be solved before a feasibility experiment can be

justified. In the area of data processing the question was raised as to whether a national computer facility should be established to expedite the development of two-and-three-dimensional computer codes for simulation of plasma properties. Several committee members from the national laboratories were concerned that such a center might hamstring the computational capabilities of the laboratories. They also communications problems might arise in divorcing the process of simulation from its now intimate and on-site relationship with ongoing experiments.

A source of concern which surfaced during the meeting was the fact that the Department of Defense appears to be pulling out of atomic and nuclear research. When it was suggested that the National Science Foundation might pick up the slack, Edward Creutz, N.S.F.'s Assistant Director for Research, said the Foundation's primary goal was to aid those areas of science that are critically underfunded rather than supporting work that other agencies want done but don't want to pay for .- David F. Salisbury

EARTH AND SPACE

Remember the Mohole?

. a plan to mount an earth-coring drill on a platform at sea and use it to make a hole through the earth's crust. It would then have given man his first



Seen looming through a fog on the high seas, Glomar Challenger-the five-yearold scientific laboratory of the Deep Sea Drilling Project-might inspire some disbelief. She is 400 ft. long and carries a drilling tower 142 ft. tall whose peak is 194 ft. above the waterline. Two important features: an automatic pipe

racker forward of the tower holds 24,000 ft. of drill pipe, and a dynamic positioning system based on thrusters linked to on-board computers keeps the ship stationary over one spot in the ocean for the hours or days needed to drill a

view of the Mohorovicic Discontinuity, the curious transition layer between crust and mantle.

When Mohole was liquidated in 1966 for a complex of scientific and political reasons, its successor was the far more modest Deep Sea Drilling Project centered at Scripps Institution of Oceanography; now that project and its principal laboratory, the D/V Glomar Challenger, have issued a fifth anniversary report showing contributions to geological knowledge which Mohole would

have been hard-pressed to match.
On Leg 31 of the Project—just concluded in Hakodate, Japan-for example, Glomar Challenger drilled deep holes in the Philippine Sea. West of the Marianas Trench its scientists found sea bottom material no older than 60 million years; just east of the Trench the sea floor is over 100 million years old. The Trench, therefore, is the place where two very different pieces of

ocean crust come together.

Another result, from the same cruise: southeast of the Nankai Trough, south of Japan, there are no sediments of Japanese origin younger than 4 million years. That date marks the age of the Trough, which now acts as a sediment trap; it is where a slab of ocean crust is sliding under the Japanese islands-the source of the large earthquakes which plague southwest Japan.

After five years of drilling in four oceans, Glomar Challenger has yet to find a rock older than 160 million years—which is very young compared with the oldest dated continental rock, 3.6 billion years. This is clear evidence for sea floor spreading and continental drift; indeed, Glomar Challenger's are the only solid geophysical data on the processes of continental drift which geologists now have. Glomar Challen-ger's next assignment, Leg 32, will be a series of cores from the ocean bottom between Japan and the Midway Islands—the largest area of the ocean's crust known to be older than 110 million years. Magnetic patterns in the crustal rocks may show their position when formed, a useful clue to the nature of continental drift. There may also be fossils to show a history of water temperature, depths, and currents in the Pacific in the era when reptiles dominated the land and ammonites (shelled octopus-like animals) the sea.

In five years-before the start of Leg 31—Glomar Challenger had drilled 431 holes at 289 sites. The deepest hole went 4,265 ft. beneath the ocean floor (in the Indian Ocean); the greatest depth of water over which a hole was drilled was 20,483 ft., also in the Indian Ocean; and the latter involved the longest drill string ever suspended beneath Glomar Challengeran astonishing 22,192 ft.-J.M.

The Greatest Show Near Earth

It could be an awesome display-the passage of the Comet Kohoutek.

There is reasonable expectation that it contains enough material to lay out a long, broad, illuminated tail on its close approach to the sun in Decem-

ber and January.

Kohoutek's Comet should become visible in mid-November as a faint smudge low in the southern morning sky. If a tail develops, we should see it by mid-December about 25° west and south of the sun. After going around the sun on December 28, the comet should become an evening object to the north and east of the sun. The best viewing will be January 10-20. At its height of visibility, Kohoutek's brightness may be between that of Venus (minus 4.2 apparent magnitude) and the moon (minus 12.7).

The orbiting iceball—discovered by Lubos Kohoutek of the Hamburg Observatory on two photographic plates exposed March 7—may last have been seen by humans before they advanced out of the hunting culture. Brian Marsden of the Smithsonian Astrophysical Observatory says its track is so extremely eccentric that its period may

be longer than 10,000 years.

By contrast, Halley's Comet has made its perihelion every 75 years or thereabouts (its orbit subject to perturbations by the planets) since its first known observation in 87 B.C. These relatively frequent solar interactions must have torn away a considerable amount of substance, yet on its last pass in 1910 it spread a spectacular tail as much as 120° across the sky.

The reasoning that leads to the expectation that Kohoutek's Comet may outshine Halley's is that the new body undergoes perihelion over 100 times less often. However, comets are not well understood. Their origins and ages are subjects of several theories, none of them generally acceptable to planetary scientists.

Thus, it may be that Kohoutek's Comet is far older (or younger), less massive (or more), largely played out (or bursting with tail material). Since Kohoutek (the astronomer) has provided nine months warning for scientists, who are planning to observe with a worldwide instrumental array that did not exist in 1910, some of these uncertainties should be resolved. As of this writing, several major observational activities were under discussion in the U.S. Among them:

-Investigation by the Orbiting Solar Observatory (OSO 7), the Orbiting Astronomical Observatory (Copernicus), and a Mariner spacecraft scheduled for launch to Venus and Mercury

in early November.

-National Aeronautics and Space Administration sounding rockets and jet aircraft carrying instruments to high altitudes (the jet, a C-141, will carry a new 91.5 cm. telescope for micron-tomillimeter observations).

-Skylab telescopes for photographing the comet over a broad range of the electromagnetic spectrum, if the satellite is occupied by the third Skylab

-A new comet observatory being set up on Old Baldy in New Mexico by the New Mexico Institute of Mining and Technology and N.A.S.A.

-Radio observations by Harvard University of the density of ammonia and by N.A.S.A. of the density of water vapor, both using the Massachusetts Institute of Technology 120-foot Hay-

stack radio telescope.

-Measurement of the reflection spectra of the comet's nucleus to determine its composition in near ultraviolet and near infrared wave lengths using several telescopes at M.I.T.'s Wallace Astrophysical Observatory; and, by the same group, a study of the structure of the tail using a highly sensitive, digital, single-frame vidicon with narrow-band filters together with a computer that will super-impose the frames in various combinations.

Many more observations will be made in the U.S. and around the world. By the time the Kohoutek object passes around the sun and departs for another 100 or so centuries, it will have left behind a good deal more than a trail of cometary debris.—R.S.

SCIENCE POLICY

Doubts by the Science Adviser?

Can the National Science Foundation transcend its past to fulfill the assignment of "the government's highest-level policy and advisory body" in science and technology?

The question, in essentially those words, was posed by Edward E. David, Jr., former White House Science Adviser, in a statement this summer before the House Committee on Science and

Dr. David's answer: Wait and see.

He sees the arrangement for a new Science and Technology Policy Office within N.S.F., replacing the Presidential Science Adviser in the White House, as "unstable" because of the Foundation's tradition of "singleminded concentration on scientific excellence to the exclusion of other factors." N.S.F. must broaden its base of concern "to comprehend the subtleties of successful innovation," to exert "technological foresight," to embrace "a powerful new set of policy issues" which include "not only science and technology but also economic, social, legal, and political factors."

Has science been downgraded by President Nixon's decision to eliminate the White House Science Adviser and depend on N.S.F.?

Dr. David insists that his answer is "No!"

"Science and technology," he told the Subcommittee, "will continue to be the warp and woof which shape our society.

But he seemed to admit some mis-givings, agreeing that "the direct in-tluence of sciencists on societal affairs has . . . been downgraded. . . . The place of deep technical thought in the national interest is too important to go vacant for very long," Dr. David told the Committee. "Science and engineering should be in a position to influence directly decision-making and program planning on the national level," and the present situation "bears close watching in the months ahead."—J.M.

A Deeper Malaise?

Appearing before the House Committee on Science and Astronautics shortly after Edward E. David, Jr. (see above), William D. Carey, who was Assistant Director of the Bureau of the Budget from 1966 to 1969 and is now Vice President of Arthur D. Little, Inc., was even more outspoken: President Nixon's decision to dismantle the White House science policy structure was "impulsive and mistaken."

The "implicit message" of such a decision is that "science and technology are no longer central inputs to national decision-making," Dr. Carey, and this is "a misreading of reality. . . . They should be viewed as public investments and managed over time with stability and with growth objectives."

If you take such a long-range perspective, Mr. Carey suspects you may find that U.S. technological performance is "running at perhaps onehalf of its rated potential;" and he wonders if the U.S. may be "gradually losing . . . its grip on technologi-

cal vitality.

Five policy needs, Mr. Carey told members of the House Committee:

-Seek some kind of index to help us "get at the truth as to whether we are losing or gaining ground in our science and technology.

-Take a new look at how government incentives can increase tech-

nological productivity.

-Review the possibility that regulatory legislation is too constraining.

-"Identify stranded or slow-paced scientific and technological oppor-tunities which are candidates for hot pursuit, with government sharing the exploration risks."

Study what other governments are doing to stimulate innovation and "not be ashamed to follow their example if we must."—J.M.

When Transit Is Not Really Wanted

You can bring mass transit even to the commuter's doorstep, but you cannot be sure he will ride-be he rich or poor, carless or automobilist, urbanite or suburbanite.

What in fact must mass transit provide before it can lure significant numbers of travellers out of traffic jams and their vehicles out of parking lots?

Two answers are summarized here. Vasant H. Surti, Director of the Center for Urban Transportation Studies at the Denver Center of the University of Colorado, and Charles A. Hall, Research Fellow at the Center, asked 2,500 employees of 11 Denver firms about their commuting preferences. And Alice E. Kidder and Arthur Saltzman of North Carolina Agricultural and Technical University studied the transportation needs and choices of residents of low-income neighborhoods in Greensboro, N.C. Neither result is calculated to raise the spirits of bus drivers or of mass transit planners.

Most Denver commuters who use the Denver Municipal Transit system say economy is its overriding advantage. Some also choose it for convenience. Only a few, relatively, say that freedom to read or work en route is a factor in

their choice.

Automobile commuters in Denver use their cars because they reach their jobs more quickly and travel with greater convenience, or because their cars are needed during the day's work. Of all the factors, convenience is cited most by Denver commuters to justify their choice of transit mode.

The same sense of priorities in transit choice was recorded by Daniel Brand, Associate Professor of City Planning at Harvard, at a recent briefing session at the Department of Transportation's Transportation Systems Center in Cambridge. He noted that only about 6 per cent of Boston commuters rely on rail transit. The reason, he thinks: they spend only about 40 per cent of their door-to-door commuting time in the rail-transit vehicle; they spend the rest of their time "doing things that research has shown are about three times as noxious to travellers on a unit-time basis as line-haul riding time." Professor Brand's prescription for new transportation systems: "Reduce walks and waits.

Surveys everywhere-including the Denver study-confirm that car ownership correlated positively with car commuting-and two-car ownership more positively. What about the habits and wishes of the "carless" urban poor, who are often assumed to be "captive riders"

dependent on public transit?

Not really so, report Professors Kidder and Saltzman in a paper given last summer at the International Conference on Transportation Research in Bruges, Belgium. At least in Greensboro, N.C., even the "carless poor" are really "auto-oriented," and many of the poor are not really carless at all.

More than 60 per cent of residents in Greensboro's low-income areas own cars, and even non-car-owners "are more likely to go to work in a car (albeit someone else's) than to ride public transit." And this is true despite the fact that Greensboro public transit has "an extensive route system with frequent service;" 80 per cent of Greensboro employment opportunities are within six blocks of a bus stop.

Studies in other cities add confirmation: among those who do not drive cars, ride-sharing and/or carpooling is used from 1.7 to 7 times as often as public transit, and ride-sharing is "more commonly used by low-income groups than by other groups as a means of getting to work," says Professors Kidder and Saltzman. Furthermore, 25 per cent of the ride-sharers pay nothing for transportation; they ride with relatives or close friends. Indeed, only 38 per cent of Greensboro's carless commuters said they would be willing to pay more than 50 cents for a one-way trip from home to job (Greensboro bus fares are 20 cents). Those who operate buses in Greensboro must find in these figures little incentive to invest in innovations and improvements.—J.M.

Productivity: the Key to Success

A member of the Rothschild family is credited with this advice on three ways to lose money most dependably: put it on horses—the fastest way; spend it on women-the pleasantest way; or invest it in aviation—the surest way.

Though the teller of that story— David L. Nicolson, Chairman of the British Airways Board, speaking last spring to a meeting of the M.I.T. Club of Washington-has no official connection with the Anglo-French Concorde project, that gloomy episode in the history of European technology may provide the best evidence yet of the Rothschilds' wisdom.

Concorde's fundamental problem was made clear by John C. Borger, Vice President and Chief Engineer of Pan American World Airways, Inc., in his 1973 William Littlewood Memorial Lecture of the American Institute of Astronautics and Aeronautics. The productivity of aircraft in commercial service (productivity being figured as the product of payload, speed, and utilization) has improved almost constantly since the days of the Ford tri-motor. But the best predictions for the Concorde leave it a major discontinuity in Mr. Borger's record of progress (see chart).

Most of the 50-year productivity improvement in American aircraft is the result of bigger and faster airplanes, able to carry more people further per hour of flight. But utilization is a factor, too, and this is a function of the dependability which aircraft manufacturers can build into their planes and the ingenuity with which airline managers can use them. Short-haul aircraft, spending more time on the ground, turn in poorer utilization records than planes used in transocean service, where the airplane flies through the night. The best of all is a flexible aircraft able to fly any part of its airline's route pattern.

Here is where Concorde loses: though it might fly transocean routes, its speed means that in terms of utilization it would "greatly resemble the short-haul transport," said Mr. Borger. It would have to be scheduled "very tightly," he said; but it would also have to cater to local time problems and avoid airport noise curfews, and all this, thought Mr. Borger, "would take some doing.

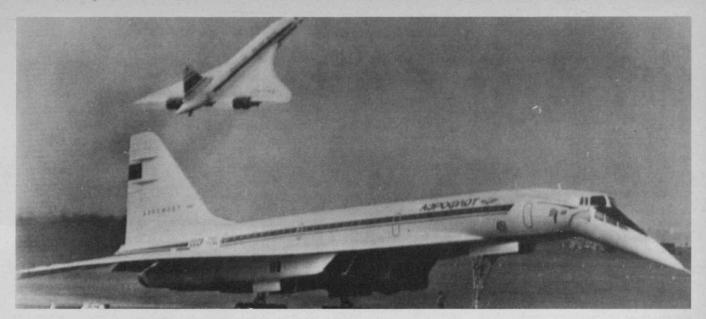
Can Concorde achieve the dependability needed for competitive productivity? The question remains unanswerable until commercial service begins, but the fact that Concorde uses more automatic control systems than any previous transport aircraft is not irrelevant.

A supersonic aircraft is inherently complex: it must fly in two modes and land in one of them, being almost two aircraft in one. Though far faster, it must use the same airport facilities as "ordinary" aircraft. Because it is two aircraft in one, its center of gravity must be movable. Many of its parts must stand thermal stresses higher than aerodynamic stresses.

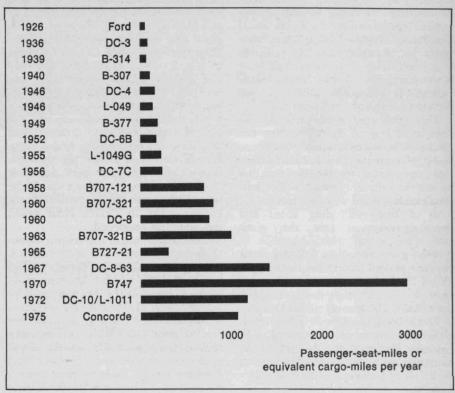
Despite these complexities, Concorde's automatic systems make it nothing more than a "conventional" aircraft for the pilot, according to Marc I. Pelegrin of the Centre d'Etudes et de

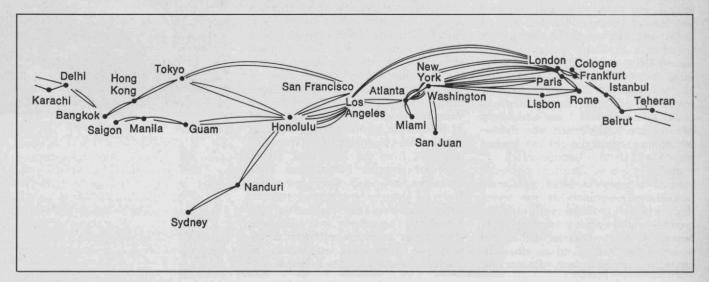
Recherches in Toulouse.

Dr. Pelegrin reviewed Concorde's systems at a seminar at M.I.T. last spring: to change the aircraft's center of gravity between subsonic and supersonic flight, fuel is automatically moved from forward to stern tanks. Electrical systems link the pilot's control to throttles and control surfaces. Variable components of the propulsion system are "highly automatized because it is beyond the pilot's competence to adjust (them)," said Mr. Pelegrin; indeed, he said, "the load of the crew has not been increased because all specific tasks due to supersonic flight are automated."-



Aircraft productivity is the product of payload, speed, and utilization, and it has been increasing with only minor discontinuities throughout the history of U.S. commercial aviation. The record (chart, right) is "a magnificent tribute to airplane and engine designers," said John G. Borger, Vice President and Chief Engineer for Pan American World Airways, in the 1973 Littlewood Lecture. But the story has a dismal end: supersonic transports (the photograph shows the Russian TU-44 on the ground and the Anglo-French Concorde airborne in Paris in 1973) will not maintain the trend to ever-greater productivity. Credit for increasing efficiency also goes to airline managements for everbetter aircraft utilization, said Mr. Borger. The map on this page shows the onemonth routing of a single Pan American B-747 in November, 1972: 77 departures, 306 hours in the air, 133,700 nautical miles. (Photo: Wide World)





A Photographer's Notes-Kenya, 1973

Owen D. Franken

Four days at Lake Rudolf in June, 1973 . . . the great eclipse . . . dust, heat, and exhaustion. My first impressions upon arrival were of incredible desolation . . . mostly dry, light brown earth with bushes scattered here and there. A row of metallic things lined up on a small piece of land sticking into the lake turned out to be the National Science Foundation site . . . a large collection of green tents was within two days to turn into a huge tourist camp.

I never entered any heavy scientific discussions at Lake Rudolf, since I was orienting myself toward anthropological aspects: the effect of the eclipse and of the scientists upon the local population. (And-having spent four years in physics at M.I.T.-esoteric technical discussions were the last thing I needed; after all, to escape them was one of the reasons that I had be-

come a photographer.)

Three groups of people came to Lake Rudolf to impose themselves on the Elmolos' lives—the scientists, the press, and the tourists. The last-named arrived en masse on Friday, the day before the eclipse, creating a close imitation of the Long Island Expressway; most of them-including about 100 Americans-moved into the green

Among the travellers I found Dave Garroway, who has become an eclipse addict. "All you need is one and you're hooked. It's as indescribable as sex," he told me. He showed me his Questar, with which he would watch the eclipse while standing in five feet of water in the lake. Shooting over the lake would eliminate the heat waves; "all I have to worry about is the crocodiles," he said.

Another interesting man at Lake Rudolf was Stanley, a Samburu, who served as translator, navigator, and bank-allowing me to photograph his friends but not him. Stanley charged me 10 shillings per friend; he also offered to sell me one of his spears-for late nights in New York, he suggested.

Another offer was from a Turkana camel herder: would I buy and marry his daughter? The price was right-100 shillings-and the girl was kind of sexy, but I foresaw visa problems.

All these interrelationships created a kind of African Woodstock, a tolerant co-existence. The scientists were trying to do a tough job in the midst of an incredibly inhospitable environment; they saw the Samburu, Turkana, and Elmolo as a colorful addition to an otherwise altogether dreary place. Except for

business relationships with Kenya officials, the scientists seemed to ignore the villagers. The tourists, having come to view the eclipse, spent most of their time playing with their telescopes, drinking in the lodge's makeshift bar, and playing bridge in their tents. The villagers took advantage of the situation by selling souvenirs frantically made by their children for the occasion, by posing for pictures (I took a picture of a man taking a picture of me and asked him for 10 shillings; he became very confused), by rescuing Land Rovers from the sand (one hole I'm convinced had been constructed as a Land Rover trap), and by selling even their own personal possessionsat prices higher than for similar goods in Nairobi. What they didn't sell they traded-for eclipse tee shirts and bumper stickers, chewing tobacco, empty film cans, and even Nile perch.

But despite their new prosperity, the Elmolo villagers worried. Turkana and Samburu witch doctors assured the Elmolo (who had a chief but no witch doctor) that the white men and their "guns" were there to shoot down the sun. And—as if this were not serious enough-that an Elmolo child would

die when this happened.

On the morning of the eclipse dozens of strips of negative film appeared as if from nowhere. They had been supplied by the safety-minded governmentand in some cases by the pictureminded press like myself. The negatives all went up as the first piece of the sun disappeared. Then as the sky slowly darkened cattle moved inland from the water and donkeys and Elmolos moved back to their homes. Five minutes before totality the Elmolo village-a desolate area about 40 yards dotted with windowless, square thatched hemispheres perhaps seven feet in diameter-was like a ghost town: the villagers were obviously hiding from the promised disaster. The village street contained an American sociologist working on a National Science Foundation grant to study the effect of the eclipse on the natives, two film crews (one American, one Japanese), newsmen from the New York Times, the Los Angeles Times, and Time magazine, me, and three brave villagers. I thought it hilarious: we had come to record the reaction of the Elmolo to the eclipse, and here were three times as many reporters as villagers—a large-scale application of Heisenberg's Uncertainty Principle.



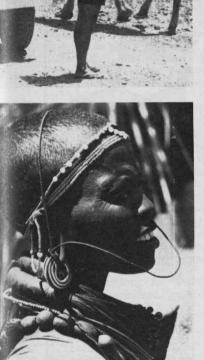
















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Quan.

Can You Prove the Nine-Point Theorem?

Well, Alice and I are settled into our apartment at Rockefeller University. It was sad to have to leave Boston. We rented a truck and did the move ourselves. Unfortunately we picked the hottest day of the year (98°) to load the truck, and the next day we unloaded it in New York in temperate 95°-weather. I've never drunk so much water in my life.

It's-a-small-world department: a familiar face in the Rockefeller University mail room turned out to belong to Sandy Hoffman (née Lazarowitz), who went through my high school and M.I.T. three years behind me. As you can probably guess, she is now a graduate student at "the Rock"—and would you believe she is our

next-door neighbor!

Starting a new volume, here's how Puzzle Corner works: every month we publish five problems and several "speed problems," selected from those sug-gested by readers. The first selection each month will be either a bridge or a chess problem. We ask readers to send us their solutions to each problem, and three issues later we select for publication one of the answers-if any-to each problem, and we publish the names of other readers submitting correct answers. Answers received too late or additional comments of special interest are published as space permits under "Better Late Than Never." And I cannot respond to readers' answers and queries except through the column itself.

Note: problems for "Speed Department" are in very short supply.

Here goes.

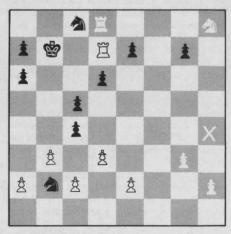
Problems

O/N1 James S. Wasvary has found the board shown at the top of the next column on which a legal chess game has just been played. What piece (black or white) is X? Zachary Gilstein wants you to prove

the nine point theorem:

O/N2 Consider a triangle. Prove that the three midpoints of the sides, the three basepoints of the altitudes, and the three midpoints of the segments joining the vertices to the orthocenter (the common intersection of the three altitudes) all lie on one circle.

The following is from Brian MacDowell O/N3 Take the digits 1, 9, 7, and 3 and, using any mathematical symbols, construct an expression yielding each num-



ber from 1 to ten (each of the four digits must be used exactly once); for example 1973 yields one.

O/N4 Winthrop M. Leeds claims that no odd integers A and B satisfy $A^2 + B^2 =$ C2 (of course C would be even). Do you

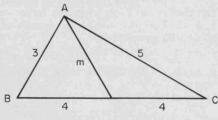
Here's one from R. Robinson Rowe: O/N5 For a problem so abSURD that you may work it twice just to be sure, evaluate exactly:

$$X = \sqrt{121 + 15\sqrt{65}} - \sqrt{(11\sqrt{2} - 5\sqrt{5})(11\sqrt{2} - 3\sqrt{13})}$$

Speed Department

SD1 H. W. Hardy wants to know how many combinations of 21 U.S. coins add up to exactly one dollar.

SD2 Norman Brenner wants you to find the length of the median m, below:



The following problems were published in the May, 1973, issue of the Review.

MAY1 With the hands shown at the top of the next column, South holds a contract for five diamonds. West's lead is ▲4. Do you want to play offense or de-

The following is from Fred Price: To paraphrase Teddy Roosevelt, the key to the problem is to walk softly and carry a small club—the \$7 to be exact. South can make his contract as follows: Win the spade lead with the A and lead the AQ. If West ducks this, the hand is simple. Cross over to the AK, take a winning diamond finesse, and cash out, losing at the end a club and a heart. Suppose West wins the AQ with the K-a likely play. His best return is probably the ♥Q, which can cover or not. Assuming the hearts are continued, you trump the second round, cross to dummy's AK, and play \$10. If East covers, win with the \$A, lead the \$7 (so carefully preserved) to the 49 on the board, take the diamond finesse, and cash out. Should East for some reason duck the \$10 when it is lead, pitch the \$7 under it and take the diamond finesse to win again. Any other leads by East/West when they win a trick puts you into the moan sequence that wins the hand.

Also solved by Bob Baird, George Holderness, Jr., Michael Kay, Ron Moore, R. Robinson Rowe, Tom Wagner, and the proposer, Paul Berger.

MAY2 Given that

$$X^{X^{X^{x}}} = 2$$
, find x.

Recall that in multiple exponentiation, the evaluation starts at the top and proceeds downward. Thus the substitution

$$u = X^{X^{X^x}} \quad \text{yields}$$

$$x^u = x^2 = 2, \text{so that } x = \sqrt{2}.$$

Now suppose we try solving the equation

$$X^{X^{X^x}} = 4$$

The same reasoning as before leads to

the conclusion that $x = \sqrt[4]{4}$. But the square root of 2 and the fourth root of 4 are precisely the same quantity, both being approximately 1.414. So we are led to the conclusion that 1.414 . . . exponentiated upon itself an infinite number of times, yields both 2 and 4. So 2 = 4. Q.E.D.! What is wrong?

R. Robinson Rowe sent the following

elegant solution:

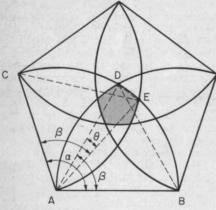
The paradox lies in the set of x for which x is convergent. If we let its value be u, then as x increases from 0 to 1.44467, u increases from 0 to e, but if x exceeds 1.44467, the exponentiation diverges and u is infinite. So the premise that u=4 is an imaginary. The derived relation may be expressed as $x^u=u$. This holds for u from 0 to e, but for greater values of u, its solution is redundant to the primitive relation. This derived relation has an infinite number of pairs, like 2 and 4, which could be used for paradoxes similar to that cleverly presented by Flerser. Another such pair is 2.25 and 3.375. All such pairs are solutions of the interesting equation $x^u = u^x$, which I dubbed the "mutuabola" for a JRM paper. In summary, 1.414 . . . exponentiated upon itself yields 2, but not 4-the latter being a redundant in the derived relation xu = u. The limit of convergence is x = 1.44467 (the eth

root of e).

Also solved by Bob Baird, Walter Hill,
Neil Judell, Peter Kramer, Albert Mullin,
Harry Nelson, John Prussing, and Harry

Zaremba.

MAY3 Find the exact area of the shaded space in the pentagon with unit sides:



Harry Zaremba sent in the following: By hypothesis AD = AE = CE = DB X = 1, triangles ACE and ADB are equilateral, and angle $\alpha=(5\text{-}2)/5\times180^\circ=12^\circ$. Let $\theta=2\beta-\alpha=120^\circ-108^\circ=12^\circ$. Let c= the length of chord DE = 2 sin $(\theta/2)$. Let $A_s=$ the area of segment DE = ½ $(\theta-\sin(\theta))$. Now A_p , the area of the pentagon within the shaded area, equals 5/4 [c² cot (180/5)] = 5/4 [4a² $\sin^2(\frac{1}{2}\theta)$ cot (36)] = $5a^2$ $\sin^2(\frac{1}{2}\theta)$ cot (36). Thus the entire shaded area = A_p — $A_s=5a^2$ $\sin^2(\frac{1}{2}\theta)$ cot (36)+5/2 $a^2(\theta-\sin(\theta)=5\sin(12)]$, which is approx-

imately 0.0790 square units.

Jordan Backler conjectures that if the pentagon is replaced by an n-gon, the answer is

 $\frac{1}{4}$ n tan ([(n - 2) (180)]/.2n) - $\frac{1}{4}$ n $\sqrt{3}$ [(6 - n)/6] π (n being at least 4).

Also solved by James Creasy, Neil Judell, Peter Kramer, Charles Landau, R. Robinson Rowe, N. F. Tsang, Don Waldman, Norman Wickstrand, and the proposer, Lee Casperson.

MAY4 Find the quadratic equation with integer coefficients ≤ 10 whose root is the nearest possible approximation to π . (Computer specialists may want to change quadratic to quintic and change 10 to 100.)

John E. Prussing has furnished the fol-

lowing quadratic:

 $2x^2 - 5x - 4$. One root is (5 - /57)/4, which is 3.1374578 to eight places. R. Robinson Rowe, without a computer, has found $18x^5 - 27x^4 - 99x^3 - 9x^2 + 100x - 34$, which has a root 3.1415845 to eight places.

Also solved by John Spalding and

Harry Zaremba.

MAÝ5 A tile contractor has laid two floors each composed of 10,000 square pieces—one floor 100 × 100 and the second 80 × 125. What is the total number of squares formed each containing only whole tiles?

The following is from Harry H. Suber: Suppose that the number of squares of all sizes in a floor which is $n\times n$ tiles is $N_n.$ By adding a row of tiles along each side to make the floor $(n+1)\times (n+1)$ note that the number of 1×1 squares is increased by 2n+1; the number of 2×2 squares by (2n-1); and in general, the number of $k\times k$ squares, by (2n-2k+1). Thus the number of squares of all sizes added to N_n is

$$\begin{array}{l} (2n+1)+(2n-1)\ldots+1\\ \\ \text{or } (n+1)^2 \text{ Since } N_1=1 \text{ it follows that}\\ \\ N_n=1+4+\ldots+n^2=\\ \\ n[(n+1)\,(2n+1)]/6\\ \\ \text{and } N_{100}=338,\!350. \end{array}$$

Now, suppose that the number of squares of all sizes in floor $n \times m$, $m \ge n$, is M_n . If a row of n tiles is added along the short side to make the floor $n \times (m+1)$ then the number of 1×1 squares is increased by n; the number of 2×2 square by n-1; and in general the number of $k \times k$ squares by n-k+1. Thus the number of squares of all sizes is increased by

$$1+2+\ldots+n=n[(n+1)]/2.$$

Since $M_n = N_n$ when m = n it follows

 $M_n = n[(n+1)(2n+1)]/6 +$

[(m-n) n (n+1)]/2.

For n = 80, n = 125, $M_n = 319,680$.

Also solved by Bob Baird, Robert Hisiger, R. Robinson Rowe, L. R. Steffens, and Harry Zaremba.

Better Late Than Never JA3 The proposor, James C. Wilcox, objects to the given solution. Not being a physicist, I can only print his comments and await adjudication:

The path of the ray of light in the given coordinate system is correct as given by Zaremba and the angle NES is 90°. However, it is not possible to measure this angle with a theodolite since the ray of light passes through point E in the given coordinate system at only a single instant of time. Anyhow, the question asked was, What angles are measured by the observers? The observers are moving with respect to the given coordinate system. It is well known that the state of motion of observers affects such angle measurements (aberration). In order to determine the measured angles correctly, we must find the directions of propagation of the light rays in the reference frames moving with the observers. We shall find the angle measured by observer N. Let the speed of each observer with respect to the given coordinate system be β meters of distance per meter of lighttravel time. The equations of motion of observers E and W in the given coordinate system are:

E:
$$x = \beta t$$
, $y = 0$
W: $x = -\beta t$, $y = 0$

We must now find the equations of motion of observers E and W in the reference frame moving with and centered on observer N. The Lorentz transformation from N's reference frame to the given coordinate system is

$$y = y'/\sqrt{1 - \beta^2} + \beta t'/\sqrt{1 - \beta^2}$$

$$t = \beta y'/\sqrt{1 - \beta^2} + t'/\sqrt{1 - \beta^2}$$

Substitution of these expressions for x, y, and t into the preceding equations gives the equations of motion in N's coordinates

E:
$$x' = \beta \sqrt{1 - \beta^2} t'$$
, $y' = -\beta t'$
W: $x' = -\beta \sqrt{1 - \beta^2} t'$, $y' = -\beta t'$

Thus, at any time, N will find a unit space vector towards E to be

$$(\sqrt{1-\beta^2},-1)/\sqrt{2-\beta^2}$$

and a unit vector away from W to be

$$(\sqrt{1-\beta^2},1)/\sqrt{2-\beta^2}$$

Since these vectors are not rotating, they must point in the directions of propagation of the light rays in N's frame of reference. Their dot product is the cosine of the measured angle. Thus the angle at N measured by the observer is

$$\alpha = \arccos\left(-\beta^2/(2-\beta^2)\right)$$

The other angles must be the same, by symmetry.

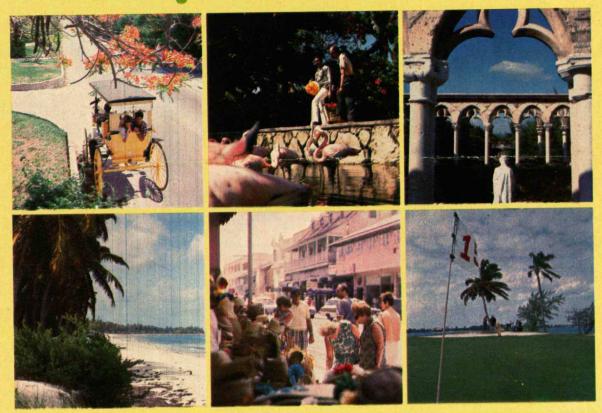
Allan J. Gottlieb studied mathematics at M.I.T. (S.B. 1967) and Brandeis (A.M. 1968, Ph.D. 1973) he is now Assistant Professor of Mathematics at York College of C.U.N.Y. Send problems, solutions, and comments to him at the Department of Mathematics, York College, 150-14 Jamaica Ave., Jamaica, N. Y., 11432.

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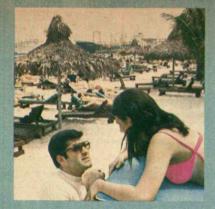
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- * Complimentary use of the Sheraton's tennis courts and golf facilities.
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shown on the front cover of this folder includes round-trip jet transportation (on charter flights) between the city of departure in the United States and Nassau in the Bahamas, transfers of persons and luggage, on arrival and departure, between Nassau's airport and the hotel, hotel accommodations, for seven nights, in the Sheraton British Colonial Hotel or equivalent, a coffee and pastry breakfast each morning, a rum swizzle drink on arrival, a drink and show at the hotel's nightclub, a glass-bottom boat ride, such free entertainment as the hotel may, at its discretion, plan for the group, a guide magazine about Nassau, the services of International Weekends Inc. tour host personnel, and Tax and Service. The phrase "Tax and Service", as used in this folder, means and includes only the taxes, tipping and service charges with respect to the included land arrangements in Nassau. The constitution of the total price for this trip (air-transportation, land arrangements, and administration) and possible price fluctuations therefor are set forth elsewhere on the back cover of this folder. The items enumerated in the first sentence of this paragraph are expressed in general terms, because International Weekends, Inc. (the "Travel Agent") reserves the right, without having to refund any monies to the passengers, to alter, change, or make substitutions in the trip, its itinerary, and its features, provided that such alterations, changes or substitutions do not diminish its aggregate fair market value of what is to be included in the trip. The price of this trip does not include expenses of The price of this trip does not include expenses of passports, items of a personal nature such as laundry, telephone, food and beverage other than specifically included, United States and Nassau Airport Departure Taxes, currently \$3.00 each (for which taxes each passenger should be invoiced before departure), or any other item not specifically stated herein to be included in the price of the trip. SINGLE RESERVATIONS: The price stated on the front cover of the brochure is per person based on double occupancy of a hotel room. Single \$59.0 reservations require an additional charge of **DOCUMENTS:** Each passenger is responsible for obtaining and having with him throughout the trip a valid passport, except that, in the case of a U.S. citizen, such passenger can substitute, in place of the passport, two of the following: a valid driver's license, social security card, voter's card, or birth certificate.

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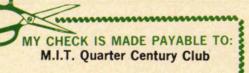
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A Tragic **Deviation from** Mama-Papa Play

Technology Review recently decided that a bridge player might write a column of interest to other bridge players among the

magazine's readers.

As for the best kind of bridge problem, there are three types. The first presents two hands and requests the optimal line of play. Since it combines mathematical knowledge of combinations with bridge skills, this type would generally be very difficult. The second is a double-dummy problem—though it would be harder than recent bridge problems in this magazine's "Puzzle Corner." Double-dummy problems are usually predicated on a complicated end position. The third is a hand played by a nationally-recognized M.I.T. star, of which there are several. This type would also be presented as a double-dummy problem. I prefer the third, since it would give me more freedom in structuring the article.

We'll begin with the first type.

Bidding—both vulnerable:

E.	S.	W.	N.
P	1 C.	P	2 C.
P	2 D.	P	2 H.
P	3 D.	P	4 C.
P	5 N.T.	P	7 C.
P	P	P	

Lead: Club x by West

This deal was the first hand of the second half in the match between the Dallas Aces (then world champions) and the young Precision Team in the Spingold Finals at the 1970 Boston Summer Nationals. At that point, the Aces were trailing by 36 IMPs. Utilizing the Blue Team Club bidding system, J. Jacoby and Wolff, of the Aces, bid aggressively to the grand slam in clubs. Jacoby's 1 club opening showed at least 17 points. Wolff's 2 club opening

showed 5 controls, where an ace is counted as two controls and a king as one control. The rest of the bidding was fairly natural, except that 5 N.T. was a grand slam try.

If clubs divide 3-2, diamonds divide

4-3, and hearts divide no worse than 6-2, the slam can be made by momma-papa play. In other words, my mother could make the slam. Declarer can win the opening club lead in his hand with the king, ruff a small diamond . . . (try playing it).

But Jacoby did not take this line of

play. He took a more probable line which, unfortunately for his team, went down. What was Jacoby's line? Why is it more probable than the momma-papa line (in

general)?

If you have a strong constitution and lots of time, you might try actually calculating the probability of success for the two lines. In order to render the problem more tractable, make the following assumptions:

1. Declarer wins West's opening club lead in his hand with the king (capturing an honor from East). Now, assume that the four cards in the first trick were never in the deck. The probability of success will

then be the fraction of these C $\begin{pmatrix} 21\\12 \end{pmatrix}$ hands which make. (It should be noted that the actual probability is approxi-

mately
$$\frac{C \binom{5}{2} \cdot C \binom{24}{12}}{C \binom{3}{1} \cdot C \binom{26}{13}} \text{ times this}$$

fraction.)

2. West's club lead is random. In other words, I don't want you to find the best

lead for each of the $C\left(\frac{26}{13}\right)$ and then

determine how many of these hands make. 3. All declarer's spots, except for the club 9, are low. Thus declarer loses all overruffs, etc.

4. Optimal defense.

These ground rules yield a reasonable simulation of the actual problem.

Please send your solutions, comments, and possible problems to me, care of the Review. I would also enjoy receiving letters from old (sad, but true) friends.

The author is a doctoral student in the Department of Chemical Engineering at M.I.T. His card-playing career began among the experts in M.I.T.'s Baker House. EXECUTIVES/PROFESSIONALS:

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RIO

See insert at page 8

Mythology on Alaska and Oil

Book Review Thomas A. Morehouse

Alaska: The Last Frontier Bryan Cooper New York: William Morrow and Co., Inc., 1973, 248 pp., \$7.95

Reviewed by Thomas A. Morehouse

On the surface, Bryan Cooper's Alaska: The Last Frontier is a largely distorted, popularized account of what happened in Alaska before and after the discovery of oil at Prudhoe Bay in 1968 and why the proposed pipeline between Prudhoe Bay and Valdez, Alaska, has not yet been built. At a somewhat deeper level, it is an occasionally skillful but mostly heavy-handed attempt to influence attitudes and decisions in favor of the trans-Alaska pipeline. His basic message is that extremist conservationists, rigid environmental regulation by the federal government, and Alaska ethnocentrism have combined to thwart the development of North Slope oil that is needed to help stave off the national "energy crisis." Meanwhile, the oil companies (particularly British Petroleum and Atlantic Richfield) that invested so much faith, money, and manpower in Alaska are unjustly being denied returns on their investments in this harsh and thankless land.

Some of the more significant distortions in the book can be demonstrated by briefly exploring three aspects of what happens when large-scale technology confronts a far northern frontier region.

Oil Under Arctic Conditions

Alaska's climate and terrain present substantial economic and engineering problems for most construction activities, but the proposed 48-inch, 800 mile trans-Alaska pipeline is in a class by itself. The single most formidable problem it encounters is that of permafrost-permanently frozen subsoil covering most of Alaska in one form or another and extending in some places to depths of over 1,000 feet. Most of the permafrost contains ice and frozen silt; once thawed, this material begins a virtually irreversible and selfperpetuating process of erosion.

The oil companies originally planned to bury their pipeline for all but about 50 miles of its route. It is now generally conceded that permafrost near a hot-oil pipeline would thaw and give way, breaking the unsupported line and leading to an environmental and engineering disaster. Mr. Cooper does not mention that it was scientists of the U.S. Geological Survey

who initially blew the whistle on the oil companies' original plan, which was based on little more than blind faith in their own capabilities to surmount any difficulty met in the field and almost total ignorance of Alaska conditions.

This book provides even less information about two other environmental problems. An above-ground pipeline will be an obstacle in the path of caribou migrations on the North Slope; and, whether above or below ground, the pipeline will pass through three major earthquake fault zones.

Preliminary findings by University of Alaska scientists, based on observations of caribou reactions to a simulated pipeline barrier on the North Slope, suggest that a pipeline will indeed affect the caribou; a large proportion will refuse to use either ramps or underpasses. These recent findings were not available to Cooper, but their likelihood was indicated to a far greater extent than he allows in his quick dismissal of the question.

Cooper also discounts the earthquake problem, barely mentioning in passing that the southern port of Valdez, the proposed terminus of the line, lies in one of the major fault zones, that the old town of Valdez was destroyed by the earthquake of 1964, and that the town had to be rebuilt on a new site.

Cooper dismisses altogether the problems associated with the storage and loading of oil at Valdez and the oil's transport in giant tankers along thousands of miles of coastline off Southeast Alaska and British Columbia. Accidental oil spills of large and small impact would be a statistical certainty-this in a region whose salmon fisheries are now among the richest in the world and where thousands of men depend upon them for livelihood and fishing has become a way of life.

Also dismissed or not mentioned at all are broader impacts of a trans-Alaska pipeline on the state as a whole-new access roads; a rapid increase in population; physical and inflationary pressures on limited housing stocks, community facilities, and goods and services generally; and increased unemployment due to a flow of job seekers from the south to a region that already has the highest unemployment rate among the states. At best, these and related impacts are simply assumed as by-products of a generally benign process of economic growth.

Cooper's approach to the environmental

problem is to emphasize the technological prowess and ingenuity of the oil industry (despite the early pipeline plan fiasco) and to associate the industry's problems in Alaska with "the nature of" Alaska's people. This leads to one of the volume's most basic messages and greatest mis-conceptions: Alaskans, generally, are either conservationist freaks or the dupes of such freaks.

This is about the last thing that public opinion, the media, and political leaders in Alaska should be charged with on the pipeline issue.

Oil and the Frontiersmen

For about two years after the 1968 discoveries at Prudhoe Bay, private entre-preneurs and public planners alike were caught up in enthusiasm, anticipating large economic gains with the construction of the pipeline and the flow of oil. Private businessmen made substantial commitments of inventory and investment, assuming that pipeline construction was imminent. In early 1970, following on the \$900 million lease sale and contemplating annual state oil revenues of \$300 million once the pipeline was operating at full capacity, Alaska officials doubled the state budget from \$150 million to over \$300 million. And at the end of 1971, the U.S. Congress, in settling the century-old Alaska Native land claims issue, in effect tied the settlement to the marketing of North Slope oil, since half of the billion-dollar monetary settlement is to be paid primarily from state mineral royalties, rentals, and

Cooper might instead have quoted—but of course he did not—the top assistant to a former governor, who said: "Hell, this country's so goddam big that even if industry ran wild, we could never wreck it. We can have our cake and eat it, too." Or the state senate chaplain who intoned at the start of a day's session not long after the lease sale: "We thank Thee, O Lord, for the oil Thou hath given us as a natural resource." And as for the oil industry's commitment to environmental protection, per se, there was the Alaska Oil and Gas Association official who remarked succinctly: "You want gas in the car? Okay, you get oil on the beach."

In Alaska, the problem is not one of opposition to the trans-Alaska pipeline; it is, if anything, one of overcommitment to it. Alaskans' negative reactions to the oil industry stem much less from fear of en-

vironmental damage than from fear that Alaskans may not have their share of the economic benefits it promises. Thus, at the same time that state leaders were somewhat desperately touring the United States seeking political support for construction of the trans-Alaska pipeline, state and oil company attorneys were preparing briefs to do battle in court over laws enacted by the 1972 state legislature to ensure that the benefits of oil development do not flow disproportionately into private hands and out of the state.

Most of the legislators who enacted these laws want oil development, including the trans-Alaska pipeline (as opposed to an alternative through Canada); they remember the commercial exploitation of Alaska's fishery, timber, and mineral resources in the colonial economy of the prestatehood period, and they don't want "outsiders" walking away with all of these new rewards. This wariness should not be confused with xenophobia or conservation-

ist extremism.

International Issues and National Forces

The issue of the trans-Alaska pipeline must finally be viewed against the background of the national "energy crisis," including its international ramifications, and the status of environmental regulation by the federal government. According to the industry version of the energy crisis, a prominent cause is unrealistic environmental laws and standards—even to the extent that industry in the U.S. is "more closely regulated by government at all levels than anywhere else in the world," writes Cooper. As a result, according to this scenario, exploration and development are stymied, lower grade fuels are kept off the market, new refineries are not built, petroleum products run short in various parts of the country, and the U.S. becomes dangerously de-pendent on foreign oil. The energy prob-lem thus becomes a club to beat conservationists-and especially Alaskans who compound their offense by biting the hand that would feed them.

The fact is that the fate of the trans-Alaska pipeline has depended on specific decisions of Congress, the federal courts, and industry officials far from Alaska-not of Alaskans. At no time has the power of decision, or even significant influence over the pipeline decision, ever existed in Alaska. As the pipeline is authorized Alaskans remain largely at the mercy of others, but there is substantial rejoicing among many of them who have believed that, if only the "outside" conservationists would leave them alone and if all Alaskans would close ranks and perform certain civic rituals, the wealth of their pipeline would at long last arrive. It is incredible that these and other pro-pipeline Alaskans, obviously predominant in the state, made so slight an impact on the author of this book.

Dr. Morehouse is Associate Professor of Political Science and affiliated with the Institute of Social, Economic, and Government Research at the University of Alaska.

Authors

Energy and Development:

A Case Study compiled and edited by William W. Seifert, Mohammed A. Bakr, and M. Ali Kettani \$11.00, paperbound

Ocean Transportation by Earnst G. Frankel and Henry S. Marcus \$27.50

The two books above are included in a series sponsored by the MIT Sea Grant Program.

Gilinson, Jr., and George A. Oberbeck Foreword by Charles Stark Draper

The authors of this monograph played a major role at the Draper Laboratory in the development of suspension devices useful in guidance systems, and their book describes and analyzes the operating characteristics of both active and passive types of magnetic and electric suspensions.

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An Institute Informant

The Editors' digest of recent and current concerns at the Massachusetts Institute of Technology

Man-Powered Flight? Not Yet . . .

Ever since spring, the M.I.T. community has waited for the word: the bicyclepowered airplane designed by a team of Institute undergraduate students has flown. In rosiest moments, the word might be that it has flown well enough to qualify for the \$25,000 prize offered by British industrialist Henry Kremer—an offer un-claimed since 1957.

But it hasn't happened yet-despite the imagination of an air-brush artist at

Yankee magazine (see photo).

Two bicyclists carried by the fragile plane will use their pedals to turn wheel and propeller toward the takeoff speed of 26 m.p.h. From then on the bicycle-powered propeller and the 62-ft. wings will keep the aircraft (126 lbs.) and the

two pedalers (more than twice that weight) airborne-if all goes well over the one-plus mile course required to qualify for Mr. Kremer's prize.

The structure is so fragile and its aerodynamics so critical that near-perfect flight conditions are essential. Hence the longcontinuing-wait for good news.

Affirmative Action Approved

The affirmative action plan to increase opportunities for minority employees, teachers, and students at M.I.T. has been accepted by the Office of Civil Rights of the Department of Health, Education and Welfare.

Indeed, says John G. Bynoe, Civil Rights Director for H.E.W.'s New England office, it makes M.I.T. "the first school of higher education in New England to develop a completely departmentalized program.

In President Jerome B. Wiesner's office to deliver the official notification, Mr. Bynoe added that "(You people) deserve a lot of praise for putting this thing to-gether. We'll be able to help a lot of universities as a result of what you've done."

New Grants and Projects Announced during the summer:

-An experiment in helping undergraduates become more innovative: Yao T. Li, Professor of Aeronautics and Astronautics, will provide a series of classes as "an organized training ground for innovators and entrepreneurs" and will set up a cooperative to evaluate and market the resulting inventions. He will use \$1.1 million (two years) from the National Science Founda-

-\$1 million from the Henry L. and Grace Doherty Charitable Foundation will help support more teaching and research in

ocean utilization.

-To identify basic research needs in transportation: six teams of M.I.T. faculty will look at intercity, urban, and interna-tional freight and passenger transport problems, try to determine what is needed to solve them, then rank these suggestions into a basic research agenda. The funding is a \$105,000 grant from National Science Foundation to Robert W. Simpson, Professor of Aeronautics and Astronautics.

-As demands rise (15 to 20 per cent each year for the last decade), urban emergency (police and ambulance) services deteriorate. What can be done?—the subject of M.I.T. research to begin this fall under a \$698,000 grant from the National Science Foundation to Richard C. Larson of the Departments of Electrical Engi-

neering and Urban Studies.

-A prototype cell culture center, now coming into being at M.I.T., will supply cultures of virus and mammalian cells to Greater Boston scientists at far less cost and inconvenience than that of growing their own cultures in their own laboratories. In charge: Phillips W. Robbins, Professor of Biochemistry, with \$403,200 from the National Science Foundation.

Divesting Draper

The Charles S. Draper Laboratory, which began in 1935 as the Instrumentation Laboratory in M.I.T.'s Department of Aeronautical Engineering, has been divested from the Institute and chartered as an in-



The ancient dream of man propelling himself through the air still hasn't happeneddespite this evidence from the August issue of Yankee magazine. It's a composite photograph created to dramatize the effort by a team of M.I.T. students to build a plane which two bicyclists can fly. BURD—Biplane Ultralight Research

Device—was shown to the press last March; development and testing have continued since then, but conditions for flight have not yet been right. So Yankee's editors admit that their picture is "slightly contrived"-an official ground-based M.I.T. photo superimposed on an air view of Southern New England.

dependent, nonprofit corporation; two years ago its defense- and mission-oriented research posture led then President Howard W. Johnson to decide on eventual separation.

Dr. Draper himself, on whose genius in using gyroscopes and computers for navigation the Laboratory's growth and achievements have largely been built, retires from its Presidency; but he retains a position as consultant and a member of its Board of Directors. Dr. Draper's successor is Robert A. Duffy, Vice President since 1971.

Science Advisers on High Technology

All six of the country's Presidential Science Advisers—Edward E. David, Jr., Lee A. DuBridge, Donald Hornig, James R. Killian, Jr., George B. Kistiakowsky, and Jerome B. Wiesner-were in the program for the dedication on October 4 and 5 of M.I.T.'s Sherman Fairchild Building for the Department of Electrical Engineering. the six appeared on Thursday evening in a symposium on "High Technology for a Livable World." And H. Guyford Stever, Director of the National Science Foundation who has inherited the Presidential Science Adviser's responsibilities, spoke at a luncheon for the M.I.T. Corporation on October 5.

M.I.T. as the Target of White House Animosity?

Six members of the M.I.T. community—more than from any other university in the U.S.—are on the White House "enemies" list which came to light during testimony by John W. Dean, III, former Presidential counsel, before the Senate Watergate investigators during the summer.

Was M.I.T. itself also in the spotlight as

a "White House enemy"?

Deborah Shapley of Science magazine, whose career in science writing began in 1968 on Technology Review, thinks so. In Science for July 20 she reported two White House memoranda dated in 1971 and 1972, the first referring to "the President's directive of a year ago to cut back on M.I.T.'s subsidy in view of Weisner's (sic) antidefense bias," the second claiming a 30 per cent cut in grants to M.I.T. making muddled references to \$71 million in grants still to be studied, including \$40 million for "Department of Defense laser development."

Miss Shapley wrote that the first memorandum, from Jon Huntsman, White House Staff Secretary, was addressed to George Shultz, John Ehrlichman, and Henry Kissinger. The second was addressed to the President from Ehrlichman. A former member of the National Security Council told Miss Shapley that the memo-randa seemed to him "entirely plausible and consistent" with administration attitudes. "I'm sure there are companion memoranda . . . about other institutions,"

he said.

Responding to Miss Shapley's questions, Constantine B. Simonides, President of M.I.T., said he could not identify funds which might correspond with either the \$71 million or the \$40 million in the alleged Ehrlichman memorandum. Indeed, federal research funds at M.I.T., said Mr. Simonides, have been rising steadily from \$154 million in 1971 to

The texts at the right are the two White House memoranda, as published in Science, which its reporter Deborah Shapley claims to have been shown; they were "confirmed as authentic by a source considered to be reliable," she writes. The first (top) was dated October, 1971, addressed to George P. Shultz, John D. Ehrlichman, and Henry Kissinger; the second, dated April, 1972, was from Ehrlichman to the President.

some \$200 million in 1973.

But the campus remains intrigued. Paul E. Gray, Chancellor, recalled for Technology Review episodes when there seemed to be "an impenetrable, incomprehensible wall down there."

President Jerome B. Wiesner told Miss Shapley, "I think it's outrageous, of course, to attack an institution for things I did as a private citizen, in the public interest, be-

fore becoming president of it."

President Wiesner was one of the six members of the M.I.T. community on Mr. Dean's "enemies" list; the other five were Bernard T. Feld, Professor of Physics who was identified with the Council for a Liveable World; Noam A. Chomsky, Ward Professor of Modern Languages and Linguistics; Daniel Ellsberg, in 1971 a member of the staff at the Center for International Studies; Edwin H. Land, Visiting Institute Professor who is President of Polaroid Corp.; and Paul A. Samuelson, Professor of Economics.

Upon reading the attached article which appeared in the Wall Street Journal on October 12, 1971 [about the ABM debate and the scientific community] it was requested that you report on the progress hat has been made on the President's directive of a year ago to cut back on M.I.T.'s subsidy in view of Weisner's [sic] antidefense bias.

Please submit your report to the Office of the Staff Secretary.

Thank you.

As you will recall, prior cuts have reduced grants to M.I.T. about 30 percent o \$71 million.

Of this some \$40 million goes to Department of Defense laser development, which

s deemed high priority

The remaining \$31 million is fair game and will be identified by contract number immediately. The best method is to order no further funding, rather than cancellation, to avoid penalty claims and lawsuits. Such an order would actually stop funds as of June 30 (71 days from now).

Either way it will take until Monday to know precisely which contracts make

up the \$31 million.

You should give guidance on these specifics:

Cut out the DOD laser program (40 million dollars)

Order no further funding of nondefense programs as of June 30, 1972 (31 million dollars).

Cancel non-defense contracts now (\$31 million less cancellation penalties)

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Continued from p. 9

meaning is a single-minded effort to achieve a specific goal within an arbitrary period irrespective of the state of knowledge. In this sense, the "N.A.S.A. approach" is expensive and uncertain and can produce baroque technology. That approach has very limited if any relevance to civilian technology. Success in this field requires a competition of ideas and experi-ments and a societal consensus achieved through the political process. That consensus is seldom clear enough to justify a monolithic approach.

Finally, new technology, particularly capital-intensive technology as in energy, requires many years to affect the world in a major way. Better insulation in buildings and houses now going up will have a major effect on total energy consumption for space heating and cooling only when the new has largely displaced the old—20 to 40 years hence. The mean life of automobiles is 8 to 12 years, and this period will delay the influence of fuel economy efforts on total fuel consumption by autos.

From my personal experience with conservationists, environmentalists, federal and state officials, academics, and industrial folk, I am convinced that a multipronged program involving contributions and viewpoints from all of these elements is developing and will be productive. What is not needed is an attempt to legislate solutions to the complex problems of energy, nor do we need a master-mind approach from the federal side.

Quality, Integrity, and Virtue

I have never been prouder of-nor angrier for-the Institute than when I read of the crude efforts to "punish" it for its Presi-dent's political—and scientific—positions (see p. 77). If M.I.T. is so hated by the people who "run" the country, it must be a place of quality, integrity, and outstand-

ing virtue.

These exposes of the thugs in the national administration can only enrage those who still use their heads to think. But they also raise the question anew: what should be the relationship between M.I.T. and the federal government? If some reports are correct, in saying that only the good word of the Pentagon kept Trixon and his German clique from wreaking vengeance on the Institute, M.I.T. may well ask itself whether the Pentagon is the best of friends to keep. Though war-mongering is the vogue at the White House now, this will hopefully not always be true.

And this episode makes it more clear than ever that M.I.T.'s long aversion to the ivory tower image of many other schools may leave it more open to the paranoid destructiveness of petty crooks in government.

Leonard Levin, M.I.T. '66 Silver Spring, Md.

"Hiring" Is Hardly the Word

In one respect, your reporting of the Georges Bank Petroleum Study executed at M.I.T. under the auspices of our Sea Grant Program (see "Oil off New England?", Trend of Affairs, June, pp. 64-65) gives the wrong impression of the thrust of the Program and of its mode of opera-

Let me assure you that the M.I.T. Sea Grant Program does not hire engineers, oceanographers, or economists. I am proud that this Program has succeeded in stimulating the interaction of such people and the formation of teams bound by common concerns and interests in order to address such specific problems as that which you reported. I am proud of this achievement in the interaction of several disciplines and in the results achieved, which have national significance.

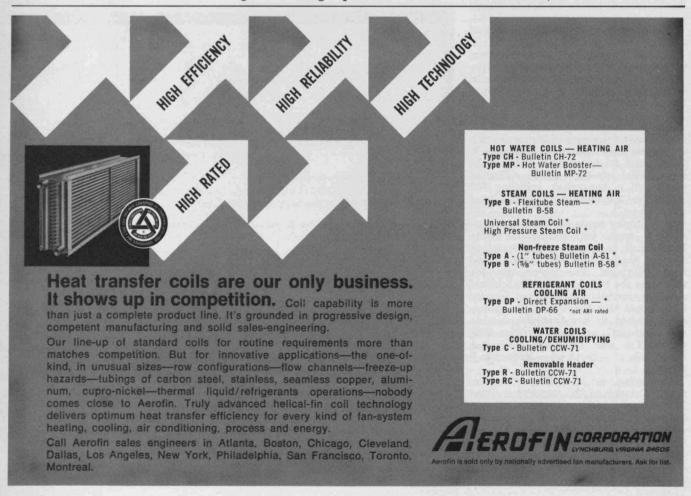
The educational accomplishments of the Georges Bank Petroleum Study are also remarkable. The Study provided an op-portunity for young faculty members to conduct a major research project. Further, the project made possible financial support for eight graduate students, and results of the research generated individual thesis topics for four of these students.

The spirit of the M.I.T. Sea Grant Program—to develop among faculty members and students a responsiveness to national, regional, and local needs, to stimulate and expand our educational program, and to provide important public servicecertainly deserves a more thoughtful description than your casual remark.

Alfred H. Keil Cambridge, Mass.

The writer is Dean of Engineering and former Director of the Sea Grant Program at M.I.T .- Ed.

(Continued on p. 80)



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Saving Coal for the Future

"The End for Coal" (see Trend of Affairs, June, p. 65) is the opposite of how it should really be.

As long as all that coal is there in the ground, it should be mined, as fast as possible, and stored up, in a readily accessible and usable form, regardless of whether or not it is actually likely to be used in the foreseeable future. Coal is such a stable fuel, particularly good for storing. In the meantime, research can be accelerated to devise better methods of converting coal to liquid and gaseous fuels as well as to other useful products.

Just as the government is preserving the railroads (in Amtrak), it would be logical for it to preserve the coal mining industry, by instituting a program to permanently mine all naturally occurring coal deposits at the maximum rate in the most efficient and modern manner, designed to obviate the problems which plague coal mining.

As Senator Adlai Stevenson has emphasized, the potentiality of such an approach should not be underestimated; to reject it for purely financial reasons could be as short-sighted (Brezhnev will agree) as when the Czar sold Alaska for purely financial reasons.

Kenneth J. Epstein Chicago, Ill.

Metrication: Some Problems

Lewis B. Simon (see "Metrication, No; Standardization, Yes!," Letters, June, p. 3) is quite right. Much of what has been said in favor of the metric system seems to be complete nonsense. For example, English and American nuts and bolts are not interchangeable, not because the size is different but because the thread profile is different. One of the outlandish arguments for the metric system some years ago was that we would not have to teach our youngsters common fractions. This, of course, would be a great help in the elementary school but would be a great burden in high school when students begin to learn algebra. It is not always realized that there are scale differences between metric and English usage. For example, aircraft wing loadings in lb./ft.2 differ by a factor of about five from those in kg./m.2.

Decimals are now commonly used with the English system. Surveyors describe town lots in feet and decimals. Machinists measure in inches and decimals. The Weather Service gives the positions of tropical storms in degrees and decimals.

Another problem: suppose we can some-thing and the can contains one pound of contents. If we change to the metric system it would be perfectly easy to put 450 grams in the can. The can would be identical in size but the contents, which people might assume to be the original one pound, would be 1 per cent short. It would be sold, however, for the same price as before. Somebody would be making an illicit profit.

Charles H. Blake Hillsborough, N.C. "Black Science"-A Blinding Illusion

I read with sadness the article "Can M.I.T. Aspire to Teach Black Science and Technology?" (Institute Review for June, p. 83). Shades of Hitler and Stalin. There is no more a Black Science than a White Science. When M.I.T. teaches Black Science it will turn into the fourth-rate school it deserves to be for teaching pseudo-science.

I am aware of discrimination. Today I am a successful patent lawyer because I was discriminated against on religious grounds when I graduated from M.I.T. in 1940 as a chemist. The problems of discrimination will not be solved by making your own rules outside the system.

Alvin Guttag, '40 Bethesda, Md.

Whatever the term Black Science may come to mean, students choose unwisely in their efforts to learn about it.

Far better for them, and for M.I.T., had they chosen schools nearer home where, ease in familiar surroundings, they could learn and discover for themselves the best way to develop the full potential of their natural talents.

Alexander Pope was right. A little learning is indeed a dangerous thing. So is a lot of learning, of the wrong kind.

Herbert B. Larner, '18 Montclair, N.J.

Affirmative Action at M.I.T.

A particularly gratifying aspect of M.I.T.'s efforts and progress in the area of affirma-tive action (see "Affirmative Actions: Be-cause It Is Right and Proper", June, p. 85) was the motivation of the Institute: despite massive federal funding, the underlying justification was not one of avoiding penalty but seeking to do that which is "right and proper."

Three comments: First, regarding the concept of utilization, it seems to me that goals for a particular employee group should be based on the availability of required skills in the local minority popula-tion. This differs from the local work force in a rather important way: it includes unemployed minorities with the requisite skills. Further, organizations which occupy positions of leadership, as does M.I.T., may also strive to increase the supply of workers in various groups through appropriate community training or upgrading programs.

Second, Dr. Wiesner's goals for further improvement are commendable in providing training and promotion opportunity but should stop short of "plain overutilization." This is just as dangerous for undermining the confidence of minorities who are "in over their heads" as for the resentment created among non-minority co-workers.

Finally, as an alumnus, I am proud to see specific programs to seek out qualified minority and female applicants who may benefit from an M.I.T. education.

James W. Taylor, '65 New Orleans, La.

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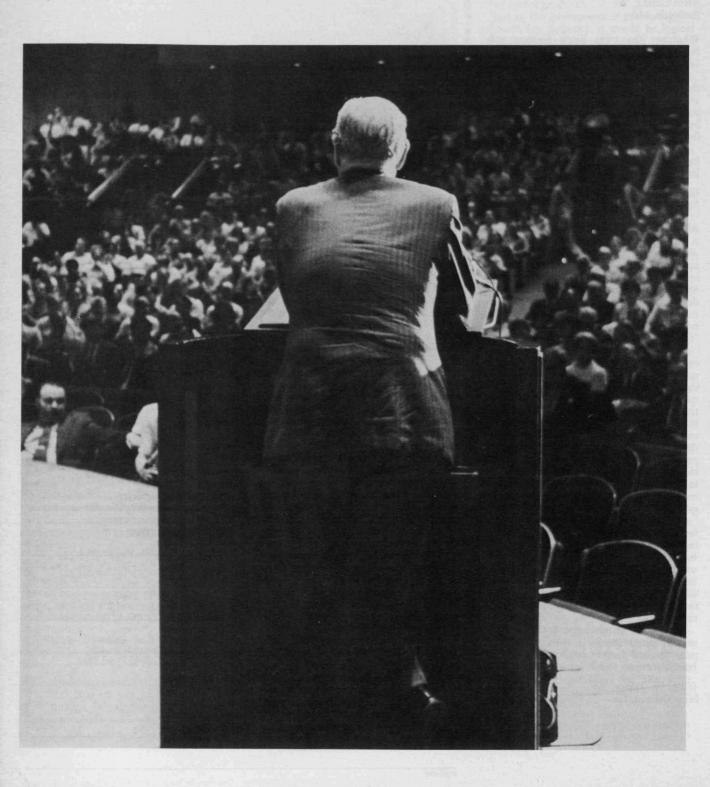
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C. Stark Draper, '26, may in his own words have had "just a couple of simple ideas in life" and "beat them for all they were worth," but in the process he won an international reputation for himself as a technological innovator and for his laboratory as a center of meticulous engineering. And he won as well a personal following within the Draper Laboratory whose loyalty and affection are

unbounded. So there is lots of nostalgia in this photograph of "Doc" Draper standing before the staff and employees of the Draper Laboratory on June 29—the last business day before his retirement as President of the Charles Stark Draper Laboratory Division of M.I.T.—and the Division's last business day before divestment. (Photo: Joshua Collins)



Institute Review

Affirmative Action Approved: It Goes "Beyond the Minimum"

The Institute's affirmative action plan to increase opportunities for minority employees, teachers, and students at M.I.T. has won substantial approval from the Department of Health, Education and Welfare's Office of Civil Rights.

The plan is "acceptable and in substantial compliance" with government requirements, wrote John G. Bynoe, Civil Rights Director for H.E.W.'s New England office, to President Jerome B. Wiesner on July 20. It "evidences a sincere and demonstrable good faith on the part of the Institute." Indeed, in some aspects it "goes beyond minimum standards of compliance," Mr. Bynoe wrote.

And it makes M.I.T. "the first school of higher education in New England to develop a completely departmentalized

program."

In President Wiesner's office to deliver his welcome letter and discuss some of its details, Mr. Bynoe is said to have been even more complimentary: "(You people) deserve a lot of praise for putting this thing together. We'll be able to help a lot of universities as a result of what you've done."

President Wiesner and others in the M.I.T. administration had been waiting for Mr. Bynoe's response since April, when the plan was submitted. Dr. Wiesner was pleased, of course; but he also sensed much work ahead: "The planning part is done, but the hard part is yet to come," he said—by which he meant the task of fulfilling the Institute's commitment to locate and hire-or admit, in the case of students-minority representa-tives "at least in proportion to their current availability."

The comprehensive affirmative action program which Mr. Bynoe's office has approved includes a two-year plan from each department and administrative unit for the number of minority-group members to be hired. These individual goals have not been made public, nor have the totals which they will represent for the Institute.

Mr. Bynoe's general comments were followed in his letter by a list of matters on which his Office of Civil Rights would like some additional details. Examples:

-An "organization chart to identify and link the various levels of authority relating to employment decisions."

-Some notion of the Equal Employment Opportunity Officer's "actual authority to initiate or enforce remedies."

-"Precision and clarity" in describing "the responsibilities and authority" of committees playing an important role in implementing the plan.

-Samples of "correspondence to be used for both internal and external dis-

semination of the plan."

-Disciplinary action "contemplated or implied in the plan for failure (of supervisors and departments) to adhere to equal employment office policies and procedures.'

In one respect M.I.T.'s plan "excelled," wrote Mr. Bynoe, and it is noteworthy in two others: its programs "to eliminate deficiencies in its affirmative action posture," its plan for extending educational opportunities, and its pledge of a "vigorous effort to enlarge the numbers of women and minority students in . . . certain highly specialized disciplines" where few if any qualified minorities are now available.

Draper Laboratory Is Divested: A Declaration of Independence, but the Mood is Nostalgic

"When in the course of human events . . the (Draper) Laboratory became largely a mission-oriented developer of highly sophisticated precision systems in which guidance was the governing factor . . a decision was made that the academic responsibilities of the (Massachusetts) Institute (of Technology) and the contractual responsibilities of the Laboratory should be separated for their mutual benefit. . . ."

Many in the audience may have taken a dim view of this paraphrase of a great historical document and of the version of history it proposed. But events set in motion three years ago, in a somewhat different world, are not to be stopped today, and on July 1 M.I.T.'s autonomous Draper Laboratory Division became the independent Charles Stark Draper Laboratory, Inc.-a nonprofit corporation chartered to engage in scientific, engineering, and educational activities.

The quotation is from a Declaration distributed to staff members and their families attending an independence celebration in Kresge Auditorium and a picnic in Rockwell Cage-hot dogs, potato salad, beer, and soft drinks-on June 29.

The Declaration was surely meant to put everyone in an optimistic mood for the future: ". . . the Laboratory accepts the opportunity to pursue its avenues of special competence on its own responsibility, free of the necessity to conform to the traditional constraints of academe. Likewise M.I.T. is free to re-orient itself more closely toward the original intent of its Charter and protect its position at the forefront of academic excellence . . .

But the mood was more nostalgic. C. Stark Draper, '26, Institute Professor Emeritus whose genius built the Laboratory (starting as the Instrumentation Laboratory in 1935), said modestly that he had had "just a couple of simple ideas in life" and "beat them for all they were worth." No one really rejoiced to find himself no longer giving M.I.T. as his place of employment and using new letterheads without the Institute watermark.

But on the eve of divestment, Albert G. Hill, Vice President for Research of M.I.T., wrote John S. Foster, Jr., Director of Defense Research and Planning, that "from all appearances the vital signs of the or-

ganization are strong.

"The necessary organizational changes have been effected with a minimum of internal disruption," he said; "the relationships with M.I.T. are cordial; and mechanisms for the two organizations to interact beneficially have been developed and approved.

"Employee morale is good," Dr. Hill wrote, "as evidenced by the fact that all but five of the nearly 1,800 Laboratory employees have accepted jobs tendered

by the new corporation."

Duffy Is President; Draper "Retires"

Divestment of the Laboratory was the occasion for some administrative changes:

-Dr. Draper, who had been its President and earlier its Director, stepped down to become the Laboratory's Senior Scientist, and a member of its Board of Directors: he "will continue to take an active part in Laboratory affairs," Dr. Draper's successor (see below) assured the picnic audience.

-Robert A. Duffy, Vice President of the Laboratory since 1971 when he retired from the U.S. Air Force, became Presi-

-Joseph F. O'Connor, Assistant to the

1 JULY 1973 eclaration:

When in the Course of human Events it becomes necessary for two Institutions to revise the Bonds which have connected them one with the other, and to assume the separate and equal Stations to which the Laws of Nature entitle them, a decent Respect to the Opinions of Mankind requires that each shall declare the causes which impel them to the Separation. ★ The Charles Stark Draper Laboratory began as the Instrumentation Laboratory of M.I.T. some 40 years ago as a teaching tool of the then Department of Aeronautics. As its skills developed its services were sought for the resolution of problems of national interest, mostly in national defense. At the behest of the government the Laboratory accepted contracts for study and execution of much needed devices to improve the country's defense posture and assure its security. Although the teaching function continued to grow, the contractual function grew faster and the Laboratory became largely a mission-oriented developer of highly sophisticated precision systems in which guidance was the governing factor. * In the late 1960s the entire educational system of the nation came under attack and institutions of learning engaged in much self-scrutiny to determine the optimum role they should play in the national interest. In the case of M.I.T. a decision was made that the academic responsibilities of the Institute and the contractual responsibilities of the Laboratory should be separated for their mutual benefit. ★ Thus the Laboratory accepts the opportunity to pursue its avenues of special competence on its own responsibility, free of the necessity to conform to the traditional constraints of Academe. Likewise M.I.T. is free to re-orient itself more closely toward the original intent of its Charter and protect its position at the forefront of academic excellence. A further plus factor for both is the opportunity to clarify and strengthen the educational interactions that have been so productive and rewarding to both in the past. ★ It is entirely fitting that this Separation take place and it is likewise fitting for us to solemnly Publish and Declare, That the Charles Stark Draper Laboratory is, and of Right ought to be a free and independent institution, with full Power to contract Alliances, establish Commercé and to do all other Acts and Things which Independent Laboratories may of right do. And for the support of this Declaration, with a firm reliance on the Protection of divine Providence we mutually pledge to each other, and to all members of the Laboratory, our Dedication and our sacred Honor.

Charles Stark Thopses
Kolear ADURY Men Mount Story Colore Mach Ctokular
James Mitchandy Kend W. Thomas Julius a Stratton



By a declaration distributed to its members on June 29, the Charles Stark Draper Laboratory proclaimed that it "is and of right ought to be a free and independent institution . . ." To celebrate the event, four of the Laboratory's best friends appeared together on the stage of Kresge Auditorium: (left to right) Al-

bert G. Hill, M.I.T. Vice President for Research; Jerome B. Wiesner, President of the Institute; C. Stark Draper, '26, Institute Professor, Emeritus, and founder of the Laboratory; and Robert A. Duffy, first President of the independent Charles Stark Draper Laboratory, Inc. (Photo: Joshua Collins)





R. A. Duffy

J. F. O'Connor



D. C. Driscoll

Vice President for Research at M.I.T., became Executive Assistant to the President of the Laboratory. He continues as well to be Assistant Secretary of the Laboratory's Corporation.

-David C. Driscoll, Assistant Treasurer of Draper Laboratory since it became an autonomous division of M.I.T. in 1970, became Treasurer of the Laboratory.

-John E. Kirk, Assistant to the President of the Laboratory prior to divestment, was named Vice President.

The Laboratory occupies 14 buildings scattered throughout eastern Cambridge near the M.I.T. campus; though the buildings are old and none was built expressly for its present use, the Laboratory has no plans to move from M.I.T.'s neighborhood.

The research volume in 1972-73 was about \$71 million, according to Mr. Duffy and is expected to rise to about \$90 million during the current fiscal year, but nearly all of the increase is attributed to subcontracting.

New Appointments to Keep the Faculty at Strength

Thirty-nine new names appear on the roster of the M.I.T. regular faculty this fall, their appointments having been announced during the summer:

Aeronautics and Astronautics

-Dieter J. Sigmar, Associate Professor (also of Nuclear Engineering), with special interest in space research and nuclear propulsion. M.S. (1960) and Ph.D. (1965) University of Vienna; Lecturer in aeronautics and astronautics, M.I.T.,

-Nawal K. Taneja, S.M.'67, Assistant Professor of Aeronautics and Astronautics. B.Sc. and Ph.D. (1971) University of London; Lecturer in aeronautics and astronautics, M.I.T., 1972-73.

Architecture

—Richard Leacock, Professor of Architecture. B.A. (1941) Harvard. Visiting Professor of Architecture, M.I.T., 1969-73.
—Richard M. Britain, Assistant Professor of Architecture. B.A. (1967) Cambridge University, M.A. (1970) University of Oregon; Instructor in architecture, M.I.T., 1971-73.

—Whitney Chadwick, Assistant Professor of Architecture. M.A. and Ph.D. Pennsylvania State University; Visiting Lecturer in architecture, M.I.T., 1972-73; history and criticism.

—Dolores Hayden, Assistant Professor of Architecture. B.A. (1966) Mt. Holyoke, M.A. (1971) Harvard; Department of Landscape Architecture, University of California, 1972-73.

Athletics

—Mary Lou Sayles, Assistant Professor of Athletics and Director of Women's Athletics. B.S. (1967) Tufts, M.S. (1972) Smith; physical education staff (dance, swimming, tennis, and gymnastics), Brandeis University, 1969-72.

Chemical Engineering

—Robert C. Armstrong, Assistant Professor of Chemical Engineering. B.S. (1970) Georgia Institute of Technology, Ph.D. (1973) University of Wisconsin; transport phenomena, chemical kinetics, fluid dynamics, molecular theory.

—Robert E. Cohen, Assistant Professor of Chemical Engineering. B.S. (1968) Cornell, M.S. (1970) and Ph.D. (1972) California Institute of Technology; Research Fellow, Department of Engineering Science, Oxford University, 1972-73; mechanical behavior and biological significance of collagen.

Chemistry

—James L. Gole, Assistant Professor of Chemistry. B.A. (1967) University of California (Santa Barbara), Ph.D. (1971) Rice University; postdoctoral research, Columbia University, 1971-73.

Civil Engineering

—Moshe E. Ben-Akiva, Ph.D.'73, Assistant Professor of Civil Engineering. B.S. (1968) Israel Institute of Technology, S.M. (1971) and Ph.D., M.I.T.; Research Assistant at M.I.T., 1968-73; transportation economics and demand.

—Stamatia Frondistou-Yannas, S.M.'70, Assistant Professor of Civil Engineering. Graduate Student, M.I.T., 1969-73.

—Francois M. M. Morel, Assistant Professor of Civil Engineering. B.S. (1966) University of Grenoble, M.S. (1968) and Ph.D. (1971) California Institute of Technology; Research Fellow, California Institute of Technology, 1971-73.

Economics

—Stanley Fischer, Ph.D.'69, Associate Professor of Economics. Assistant Professor of Economics, University of Chicago, 1969-73; monetary theory and macrotheory.

—Jerry A. Hausman, Assistant Professor of Economics. Ph.D. (1973) Cambridge University.

—Hal R. Varian, Assistant Professor of Economics. Ph.D. (1973) University of California (Berkeley).

Electrical Engineering

—Chathan M. Cooke, Ph.D.'70, Assistant Professor of Electrical Engineering. S.M. (1966) and Ph.D. M.I.T.; Lecturer in electrical engineering, 1971-73; high voltage engineering.

—Berthold K. P. Horn, Ph.D.'70, Assistant Professor of Electrical Engineering; S.M. (1968) and Ph.D. M.I.T.; Research Associate in electrical engineering, M.I.T., 1971-73; computer science.

Engineering

—J. Herbert Hollomon, '40, Professor of Engineering. S.B. and Sc.D. (1946) M.I.T.; General Electric Research Laboratories, 1948-62; Assistant Secretary of Commerce for Science and Technology, 1962-67; President of the University of Oklahoma, 1968-70; Consultant to the President and Provost, 1970-72, and Visiting Professor of Engineering and Director of the Center for Policy Alternatives, M.I.T., 1972-73.

Management (Sloan School)

—Henry D. Jacoby, Professor of Management. B.S. (1957) University of Texas, M.P.A. (1962) and Ph.D. (1967) Harvard; Research Associate in the Kennedy School of Government, Harvard, 1967-70; Assistant and Associate Professor of Political Economy, Harvard, 1970-73; water resources and management.

—Richard A. Cohn, Assistant Professor of Management. Sc.D. (1973) Stanford.

—Ralph Katz, Assistant Professor of Organizational Psychology and Management. B.A. (1966) Carnegie-Mellon, M.B.A. (1968) and Ph.D. (1973) University of Pennsylvania; Teaching Assistant, University of Pennsylvania, 1972-73.

—Peter G. W. Keen, Assistant Professor of Organizational Psychology and Management. B.A. (1963) Oxford, M.B.A. (1969) and Ph.D. (1973) Harvard Business School; Assistant Professor, Harvard Business School, 1972-73.

-Gary L. Lilien, Assistant Professor of

Management.

—Peter Lorange, Assistant Professor of Management. B.A. (1966) Norwegian School of Economics and Business Administration, M.A. (1968) Yale, Ph.D. (1972) Harvard; Assistant Professor, IMEDE Management Institute (Switzerland), 1972-73.

-Roy E. Marston, Assistant Professor of Management, Ph.D. (1973) Northwestern

University.

—Kenneth S. Mericle, Assistant Professor of Industrial Relations. B.S. (1967) and M.S. (1969) Iowa State, Ph.D. (1973) University of Wisconsin; Research Assistant, 1971-72, and Teaching Assistant, 1972-73, University of Wisconsin.

—Eric A. von Hippel, S.M.'68, Assistant Professor of Management. A.M. (1964) Harvard, Ph.D. (1973) Carnegie-Mellon; management consultant with McKinsey and Co., 1964-66.

Mathematics

Richard P. Stanley, Assistant Professor of Applied Mathematics. Postdoctoral fellow, U. of California (Berkeley), 1972-73.
 William P. Thurston, Assistant Professor of Mathematics. B.A. (1967) New College, Ph.D. (1972) University of California; Institute for Advanced Study (Princeton), 1972-73.

Meteorology

—John E. Hart, Sc.D.'70, Associate Professor of Meteorology. B.A. (1961) Miami University. National Center for Atmospheric Research, 1970-73; atmospheric physics.

Naval Science

—Kevin J. O'Toole, Nav.E.'57, Professor of Naval Science and Commanding Officer of the Naval R.O.T.C.; also Professor of Naval Architecture and Commanding Officer of the Naval Administrative Unit. S.M. and Nav.E. (1957) M.I.T.; Officer in Charge of the Annapolis Laboratory, Naval Ship Research and Development Center, 1970-73.

Nutrition and Food Science

—Nicholas Catsimpoolas, Associate Professor of Food Biochemistry. B.A. (1955) University of Athens, M.S. (1962) and Ph.D. (1964) University of Tennessee; Gustav V Research Institute, Stockholm, 1958-60; Senior Research Scientist at the Central Soya Research Center and Adjunct Associate Professor of Biochemistry at Loyola University, 1970-73; protein chemistry and protein analysis.

Ocean Engineering

—Judith T. Kildow, Assistant Professor of Ocean Engineering. B.A. (1964) Grinnel College, M.A. (1965) and Ph.D. (1972) Tufts; Research Associate in ocean engineering, M.I.T., 1972-73.

Philosophy

—Barbara Herman, Assistant Professor of Philosophy. Fellow of the Center for Humanities, Wesleyan University, 1971-73.

—Paul Horwich, Assistant Professor of Philosophy. B.A. (1968) Oxford, M.A. (1969) Yale, Ph.D. (1973) Cornell.

—Izchak Miller, Assistant Professor of Philosophy. Ph.D. (1973) University of California (Los Angeles).

Political Science

—Francine F. Rabinovitz, Ph.D.'65, Associate Professor of Political Science; also Associate Professor of Urban Studies. B.A. (1961) Cornell; Department of Political Science, Rutgers, 1965-66; Assistant Professor of Political Science, University of Florida, 1966-68; Assistant and Associate Professor of Political Science, University of California (Los Angeles), 1968-73.

Urban Studies and Planning

—Charles J. Libby, Assistant Professor of Urban Studies. A.B. (1966) and M.F.A. (1969) Princeton; Research Associate, 1971-72, and Instructor in Urban Studies, M.I.T., 1972-73.

Eight Among the Year's Distinguished Visitors

Plans which bring eight distinguished scientists and engineers to M.I.T. in 1973-74 as visiting members of the teaching and research staffs were announced during the summer:

—Secor D. Browne, former Chairman of the Civil Aeronautics Board, returns to M.I.T. as Visiting Professor in the Department of Aeronautics and Astro-

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nautics; he'll be involved in planning an advanced study program in air transportation, an interdisciplinary proposal to help workers in air transport with advanced study in economics, management, operations, law, and technology at M.I.T. No stranger to the Institute, Mr. Browne first taught here in the Department of Modern Languages in 1958. -Paul J. Flory, Jackson-Wood Professor of Chemistry at Stanford, is at the Institute for the fall term as Visiting Professor of Chemical Engineering, teaching (jointly with Edward W. Merrill, Sc.D. '47, Professor of Chemical Engineering) the physical chemistry of polymers. Dr. Flory (B.S. 1931 Manchester College, Ph.D. 1934 Ohio State University) was Professor of Chemistry at Cornell from 1948-56, Executive Director Research at Mellon Institute from 1956-61, and Head of the Department at Stanford from 1967-69.

-Hubert E. Jones, formerly Lecturer in the Department, is Visiting Associate Professor of Urban Studies and Planning. He came to the Institute as a member of the Community Fellows Program in 1971 following academic study at City College of New York (B.A.) and Boston University (M.A., social work).

-George B. Kistiakowsky, Professor of Chemistry, Emeritus, at Harvard who was Science Adviser to President Eisenhower from 1959-61, is Visiting Scholar in the Center for International Studies. He is working with Eugene B. Skolnikoff, '49, Director of the Center, in studies of international policy implications of technological change.

-Wilbur G. Lewellen, Ph.D. '67, Professor of Business Finance in the Krannert Graduate School of Industrial Administration at Purdue University, is Visiting Professor in the Sloan School of Management; he'll teach in the field of finance. A familiar figure at M.I.T., Dr. Lewellen first came here from Pennsylvania State University; he holds S.M. (1961) and Ph.D. degrees from the Sloan School of Management.

-Giuliana C. Tesoro, who came to M.I.T. in 1972 as Senior Research Associate in mechanical engineering, will teach in that Department this year as Visiting Professor; her Ph.D. is from Yale (1943), following undergraduate work in Italy. -Harvey M. Wagner, Ph.D. '60, Professor of Management at Yale, will come to the Sloan School of Management as Visiting Professor for the spring term 1974; he'll teach management science and operations research. Dr. Wagner's earlier degrees were from Stanford-B.S. (1953) and M.S. (1954).

-Hans H. Weber, Professor of Management at the University of Berlin, is at M.I.T. for the year to teach operations research as Visiting Professor in the Sloan School. His degrees are from the Universities of Mannheim and of the Saar (Ph.D. 1965).

Three Professorships: Thomson, Jackson, and Noyes to Haus, Smullin, and Waugh

Three long-time members of the faculty have new names-endowed professorships-behind their names, and two of the names are new. Not a riddle:

-Hermann A. Haus, Sc.D.'54, is the first Elihu Thomson Professor of Electrical Engineering; his professorship, now fully funded, honors "a major contributor to the development of the electrical indussays the M.I.T. News Office announcement.

-Louis D. Smullin, S.M.'39, Head of the Department of Electrical Engineering, is now Dugald Caleb Jackson Professor of Electrical Engineering—the chair vacated by Gordon S. Brown, '31, upon his retirement in June.

-John S. Waugh, whose specialty is the powerful spectroscopic method known as nuclear magnetic resonance, is the first Arthur A. Noves Professor of Chemistry.

Here are some details:

Elihu Thomson's name was closely linked with the Institute early in this century; he was nonresident Professor of Applied Electricity, a long-time member of the Corporation (1898-1937), and Acting President for two years (1920-21 and 1922-23); his work was in electromagnetics, and it is no coincidence that this field is also Dr. Haus'-the interaction of electromagnetic fields and polarizable matter, notably nonlinear optical effects using CO2 lasers.

Professor Haus is known for both "superb teaching and an illustrious research career"-the quotation from his citation for the Westinghouse Award of the American Society for Engineering Education in 1971; he had come to M.I.T. as a graduate student just 20 years before, after studies at Union College (B.Sc. 1949) and Rensselaer (M.E.E. 1951).

His seven years as head of M.I.T.'s largest department make the Jackson Professorship "particularly appropriate" for Professor Smullin, thinks Dean Alfred H. Keil of the School of Engineering. That's because Professor Jackson himself had such a long tenure in the same post: 28 years, starting in 1907; and because it was the Department under Professor Jackson which "set a standard of excellence in engineering education for the country."

Professor Smullin has come to the Institute four times-once as a graduate student (following his first degree at the University of Michigan in 1936), once as a staff member of the Radiation Laboratory where he directed the microwave gas discharge group, once to head the microwave tube laboratory in the Research Laboratory of Electronics, and finally to become Associate Professor of Electrical Engineering (1955). He's been Head of the Department since 1966.

Dr. Noyes founded M.I.T.'s Research Laboratory of Physical Chemistry when chemical research in universities was a new idea, and he also had a big part in developing graduate education here-M.I.T.'s first Ph.D. degrees went to three students from that Laboratory.

Professor Waugh's physical chemistry is a very different business, but it attacks essentially the same problem: the structures of atomic nuclei and molecules, and how those affect their chemical properties. A special problem is to learn these details with only tiny concentra-tions of molecules, such as are often encountered in biological research.

Administrative Changes: Nobody Stands Still (for Long)

New desks have been found for nine new members of the M.I.T. administration during the summer. Here is the list:

-Ellen Burbank, who worked for several years with the M.I.T. News Office in charge of publicity for art, music, and cultural events, has migrated to the Council for the Arts at M.I.T., where she is Associate Director.

-Robert C. Di Iorio, former Director of Information Services at Bridgewater State College, has joined the M.I.T. News Office as Assistant Director. He's been a newspaper reporter for 15 years following graduation from the University of Rhode Island (B.S. 1958)—on the West-erly Sun, the New Bedford Standard-Times, the Boston Herald Traveller, and the Boston Herald American (Assistant

City Editor).

-You'd like a job keeping M.I.T.'s oceanographic vessel shipshape for tours of Boston Harbor and Massachusetts Bay? Too bad, you're too late; the lucky candidate is Fred C. Fegley, who's been appointed Captain of the R. R. Shrock. Mr. Fegley has been as an independent boat operator out of Woods Hole in the summers while holding down (apparently reluctantly) the job of Assistant Director of Residents in the Boston University Dean's Office in the winters. R. R. Shrock had been without a captain for some months when Mr. Fegley took the job, and he says there's a lot of work to be done: "She's not looking very pretty."

-When the Charles Stark Draper Laboratory, Inc., completed divestment from M.I.T. on July 1 (see above), David C. Driscoll took the full-time job as its Treasurer; his part-time post as Treasurer of the M.I.T. Development Foundation, Inc., was vacant-and shortly went to John O. Flender, '54. For 10 years beginning in 1960 Mr. Flender was Treasurer of the Hampshire Chemical Corp; he became a division Vice President of W. R. Grace and Co. upon Grace's acquisition of

Hampshire.

-Bruce MacDonald is now Assistant Director of Exhibitions at M.I.T., and it's announced that he will succeed Wayne V. Andersen, Professor of the History of Art, as Director of Exhibitions next summer. Dr. MacDonald studied art history at Trinity College (Hartford) (B.A. 1961) and Harvard (M.A. 1967, Ph.D. 1973), had museum training at Harvard's Fogg Museum, and interned in curatorial training at the Museum of Modern Art, New York, in 1967-68.

-Dennis L. Meredith, who has won prizes as a science writer at the University of Wisconsin and the University of Rhode Island, is now Assistant Director of the M.I.T. News Office; he'll edit the Reports on Research newsletter and report for other media on scientific developments at the Institute. Trained at the University of Texas (B.S. 1968) and the University of Wisconsin (M.S. 1970), he won the Westinghouse Science Writing Award from the American Association for the Advancement of Science in 1972 for a series on nuclear power plant siting problems.

-Technology in search of a problem Is Arthur B. Clifton's problem: he is the first Marine Liaison Officer of the M.I.T. Sea Grant Program, and his job is to show how marine research at M.I.T. can be applied to problems in the field. Mr. Clifton came here from the job of directing operations and administration for the Marine Resources Division of Avco Corp. in Lowell; he's also worked with Minneapolis Honeywell since graduating from Boston University in 1950.

-Roy Lamson, Special Assistant to the President for the Arts, says that the Council for the Arts at M.I.T. is now "fully operational"-and that there is a growing problem of staff work to effectively use the volunteer effort which is available. Hence the appointment of Peter M. Spackman, Assistant Director of the M.I.T. News Office, to be Director of the Council. Before arriving at M.I.T. in 1971, Mr. Spackman had been Editor of the Columbia University Forum and of Cultural Affairs, a publication of the Associated Councils of the Arts; he studied at Princeton and the Graduate School of Journalism at Columbia.

-A new look for the Campus Patrol: Maureen Twomey, a South Boston housewife who is the unit's first patrolwoman. She's a trained nurse, a native of Ireland; and this is her first regular full-time job since raising a family of three.

Changes in Humanities: the New **Dean's First Appointments**

Harold J. Hanham, who became Dean of the School of Humanities and Social Science in the spring, has announced two major administrative appointments in the School:

-Donald L. M. Blackmer, Professor of Political Science who has been that Department's Executive Officer, has been named Associate Dean of the School. "His first assignment," said Dean Hanham, "will be the revision of the present Institute humanities requirements.'

-James W. Harris, Ph.D.'67, Professor of Spanish and Linguistics, is Head of the Department of Foreign Literatures and Linguistics; he succeeds William F. Bottiglia, Professor of Foreign Literatures and Humanities, who wishes to devote more time to academic activities.

Professor Blackmer first came to M.I.T. in 1956 to study modern European communist parties in the Center for International Studies; he served for several years as the Center's Assistant Director, joined the faculty in 1961, and became the Department of Political Science Executive Officer in 1972. He's a Harvard man: A.B. (1952), A.M. (1956), and Ph.D. (1967).

Dean Hanham says he also expects his new associate to work on new programs in the School and to share "the exciting task of building closer relations" between the humanities and other schools at M.I.T.

Professor Harris is the author of the standard reference work on the phonology of Spanish. He's been at the Institute since 1964, when he arrived as a Ph.D. candidate; his earlier degrees are from the University of Georgia (B.A. 1953) and Louisiana State University (M.A. 1962). In



R. C. Di Iorio





F. C. Fegley

B. MacDonald





M. Twomey

D. L. Meredith





D. L. M. Blackmer

J. W. Harris



Some 2,000 curious Cambridge residents came to the open house when M.I.T. announced completion of this apartment building in Cambridgeport. Its 181 units are reserved for low-income elderly Cam-

bridge residents; the building is one of three in an M.I.T.-sponsored "turnkey" project to help alleviate Cambridge's housing squeeze which is especially severe for longtime, low-income residents.

between were study and teaching experiences at the Instituto Tecnologico de Monterrey and the Universidad Nacional Autonoma in Mexico, the U.S. Naval School of Music, and the Modern Language Materials Development Center in New York City.

M.I.T. Opens 181 Apartments —and Gives Them All to the Cambridge Housing Authority

A housing program first announced in 1969, through which M.I.T. acts as a catalyzer for new low- and medium-income housing for Cambridge, is coming to fruition.

Completion of the first unit was the occasion for a neighborhood party in Cambridgeport this summer. Paul E. Gray, '54, Chancellor of the Institute, and Mrs. Paul Mary Castriotta of the Cambridge Housing Authority made speeches, and they buried a time capsule with a scroll showing the names of Cambridgeport residents who worked with M.I.T. to do the job.

The first building, on Hamilton between Pearl and Brookline Streets, has 181 apartments; their tenants, selected by the Cambridge Housing Authority, will be 62 or older with incomes not over \$5,200 (couples) or \$4,600 (single persons), and rents will not exceed one-fourth of that income.

In all, the three buildings in the M.I.T.-sponsored housing program will provide 684 units in three different sections of the city. All have been built by M.I.T. under the "turnkey program" of the U.S. Department of Housing and Urban Development: the Institute has arranged to buy the land and build the apartments, which are then turned over to the Cambridge Housing Authority; M.I.T. is reimbursed for its costs, and C.H.A. becomes owner and operator.

Fire-Fighting Robot? Fire Locator? SCORE Asks How to Fight Fires

Last year it was to design an ideal motor vehicle for use in congested American cities.

Next year it will be hardware for preventing and fighting fires.

Student Competitions on Relevant Engineering, Inc. (SCORE), a non-profit organization based at M.I.T., has called on U.S. engineering students to put their minds to "innovative, practical hardware for the prevention, detection, and sup-

pression of fires of every description."

The results will be tested—and winners announced—in March, 1974; already 40 schools have entered, and as many more are expected to sign up by fall.

Charles M. McCuen, Research Associate in M.I.T.'s Urban Systems Laboratory who is President of SCORE, says there are five areas of competition—fire prevention, detection, fire fighting, protection and rescue, and fire fighting systems. Some examples of entries expected are flameproof building materials and textiles, spray systems and flameproofing chemicals, fire detection systems, fire warning systems, instruments for locating fires, fire extinguishers, fire-fighting robots, fire truck designs, high-rise building rescue systems. . . .

SCORE's decision to run its 1974 competition on fire-fighting technology was based on demonstrated national need, says Mr. McCuen: 12,000 people are killed and 400,000 injured by fire each year in the U.S., and property loss is

close to \$2.75 billion.

\$4 Million for Research and Teaching

Six grants totalling some \$4 million were announced at M.I.T. during the summer. Here are details:

Innovation for Training Innovators

To help undergraduate students become innovators, Yao T. Li, Sc.D.'39, will develop a series of "socio-technological innovation seminars" and an "innovation cooperative" with a two-year \$1.1 million grant from the National Science Foundation.

The idea, says Professor Li, is to provide "an organized training ground for innovators and entrepreneurs." The method—over-simplified—will be given students, "in addition to a sophisticated education, exposure to the need for innovation, a pat on the back when deserved, a hint at the right moment, and the possibility of reward—and set them loose to get their hands dirty and fall flat on their faces once in a while."

The seminars will be devoted to fostering innovative ideas and to building working models of actual products that seem to have market potential. The best student proposals will be promoted by the "innovation cooperative" with help from experienced industrialists; if all goes very well, there may be manufacturing licenses or new spin-off companies. Dr. Li thinks the whole innovation program might be self-supporting on the basis of its inventions' royalties and profits after the first five years.

It's Dr. Li's notion that the U.S. can no longer rely on "self-made men born with innovative talents"—Edison, Ford, the Wright Brothers, even Edwin H. Land. The trouble is that break-through inventions are likely to be more complex now, the rewards for them fewer, the constraints on their success higher. "What we need," he says, "is an organized training ground for innovators."

What Can We Do with the Oceans?

Hoping for better answers to that question, the Henry L. and Grace Doherty Charitable Foundation (of Darien, Conn.) has given \$1 million to M.I.T. Of the total, \$750,000 will support promising junior faculty (they'll hold Henry L. Doherty Professorships in Ocean Utilization) whose research and teaching interests are in that field; and \$250,000 will be used for research by new faculty members in ocean waves and currents, marine chemistry, and sea floor structure.

Walter A. Rosenblith, Provost, says the Doherty Professorships-which he will administer and which will be in the Department of Ocean Engineering-ought to encourage young teachers and researchers who want to get into the emerging fields of ocean science and utilization; indeed, he called this kind of support "crucial in the development of competent leaders" in such a new field.

Needs in Transportation? Name Some

What are the country's most crucial transportation problems, and what basic research will help solve them?

Answers to the two questions are not obvious, so the National Science Foundation has commissioned them from the Center for Transportation Studies at M.I.T. A grant of \$105,000 under N.S.F.'s program of Research Applied to National Needs (R.A.N.N.) will be used, and the study will be directed by Robert W. Simpson, Ph.D.'64, Professor of Aeronautics and Astronautics.

Six areas of transportation will be involved-intercity urban, and international passenger and freight. Each area will be studied by a team including faculty in engineering, architecture, urban studies, economics, political science, and management. Finally the teams will come together to rank the problems which each has identified according to importance and solubility.

The final report, thinks Professor Simpson, should show strategies for future basic transportation studies. With good fortune, the project will also help the M.I.T. Center produce the "multidisciplinary 'renaissance men' to create new understanding of our transportation prob-

Emergency Services: Up, not Down?

"Innovative Resource Planning in Urban Public Safety Systems" is the ambitious title of a two-year study of emergency police and health services and how they can be improved. Richard C. Larson, '65, Associate Professor of Electrical Engineering and of Urban Studies, will tackle the job with a \$698,000 grant from the National Science Foundation.

Professor Larson says that he and his 18 associates-10 members of the faculty and eight full-time research assistantswill examine public safety programs in Boston and Cambridge, but he thinks the results will be applicable to other cities.

Some of the questions: the effects of police employee associations, team policing, automatic car locator systems, centralized ambulance services, new fire-fighting technologies . .

In some cities demands for emergency help have risen 15 to 20 per cent a year in the last decade, says Professor Larson; hard-pressed cities have been unable to keep pace, and the result has often been a reduction in the quality of service provided. Isn't there a better way? he asks.

Sea Grant Program: At Least \$1 Million

M.I.T.'s 1973-74 grant under the National Oceanographic and Atmospheric Administration's Sea Grant Program will total \$606,100; matching funds contributed by the Institute, the Commonwealth, private industry, and a few other educational institutions mean that the Institute's Sea Grant program will operate with more than \$1.1 million in the current fiscal year.

Ira Dyer, Head of the Department of Ocean Engineering who directs the Sea Grant Program at M.I.T., says the money will go for a wide variety of teaching, research, and advisory activities-including some in cooperation with the Woods Hole Oceanographic Institution, the University of Massachusetts, Harvard Law School, the Maine Maritime Academy, several state agencies, and some industrial firms. He expects some 27 graduate and 26 undergraduate students to be involved.

In the image of the land grant college programs begun a century ago, the Sea Grant Program now emphasizes its advisory services—symposia, special reports, and bibliographic and reference helps centered in a Marine Resources Information Center at M.I.T.

The Sears, Roebuck of Cells

Where do you go, if you want a cell culture of a virus on which you'd like to do some tests?

Next year, come to M.I.T.

Phillips W. Robbins, Professor of Biochemistry, is now developing a prototype cell culture center to grow and supply virus and mammalian cell cultures to life scientists throughout the Greater Boston area; he will spend a \$403,200 grant from the National Science Foundation.

If the project is successful, it may become a model for other similar centers elsewhere in the U.S.

The point is that biomedical scientists often need large amounts of living cells. With special equipment these can be grown-in combination with other scientists' orders-easily enough. But cell cultures are difficult and often too expensive for smaller, individual research operations. Harvard, Massachusetts General Hospital, the new M.I.T. Center for Cancer Research, and M.I.T. academic departments are expected to be among the first customers.

In addition to its function as a source of supply, the new cell culture center will provide a laboratory for scientists interested in growing large-scale cell cultures and how they grow.

The Killian Award to Weisskopf: "One of M.I.T.'s Great People

James R. Killian, Jr., '26, Honorary Chairman of the Corporation, was enthusiastic when he learned of the faculty's choice for the 1973-74 James R. Killian, Jr., Faculty Achievement Award: Victor F. Weisskopf, he said, is "one of M.I.T.'s great people."

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Professor Weisskopf, who has been Head of the Department of Physics since 1965, was described by the selection committee as "a sought-after friend, colleague, critic, and teacher to those of us at M.I.T." But it was his distinction as a physicist which led the committee to give Professor Weisskopf the \$5,000 award established a year ago to recognize "estraordinary professional accomplishments" by members of the faculty.

The selection committee described Professor Weisskopf's accomplishments as "of far-reaching importance and impact in three major areas-quantum field theory, the theory of nuclear structure, and the theory of nuclear reactions.' They also noted his "deep interest both in the unity of physics and of science. It has led him to keep abreast of developments in all branches of physics and to take great pleasure in looking beyond (and through) the sometimes complex quantified descriptions of physical phenomena for the essential elements."

The award itself honors Dr. Killian for his services to M.I.T. as President, Chairman of the Corporation, and Honorary Chairman. The committee for 1973-74 included Professors Patrick M. Hurley, Ph.D.'40 (earth and planetary sciences), Richard M. Douglas (humanities), Kenneth A. Johnson (physics), Jack P. Ruina (electrical engineering), and Peter Temin (economics). The first Killian Award was given a year ago to Dr. Nevin S. Scrimshaw, Head of the Department of Nutrition and Food Science.

A Third Joint Harvard-M.I.T. **Faculty Appointment**

Three scientists now have the honor of ioint appointments at Harvard and M.I.T.

The third, newcomer to the exclusive rank, is Gerald E. Sacks, a leader in the emerging field of mathematical logic, who first came to M.I.T. as Visiting Associate Professor of Mathematics in 1966 and became Professor of Mathematics at the Institute one year later.

Now he will be Professor of Mathematics as well at Harvard, dividing his time equally between the two universities. His interests as a scholar cover the full spectrum of the field of mathematical logic, which in turn draws from both mathematics and philosophy, and Dr. Sacks will have graduate students at both

Harvard and M.I.T. studying especially in this field.

Joint Harvard-M.I.T. professorships are also held by Roman Jakobson, a distinguished linguist, and Dr. Irving M. London, Director of the M.I.T.-Harvard Joint Program in Health Sciences and Technology.

Dr. Sacks studied electrical engineering (B.S., M.S., 1958) and mathematics (Ph.D., 1961) at Cornell and then spent a year at the Institute for Advanced Study at Princeton before returning to join the Cornell faculty. He is clearly identified with the group of faculty at M.I.T. and Harvard whose work during the last 15 years has served to develop and focus the intellectual area of mathematical logic and is well known for books, articles, and papers (including major invited addresses) in the field.

The Alumnae: Basically Satisfied But "Being a Woman" Hasn't Helped

If you're a woman who graduated from M.I.T., it's statistically probable that:

-You are employed full-time (surprisingly, more than half of M.I.T.'s alumnae

-If your work is at an academic institution, you have a relatively low rank. (Among alumnae, research associates, for example, outnumber all associate and full professors and deans.)

-Your salary is between \$10,000 and \$12,500-and you tend to think your pay is about the same as that of an equivalently qualified man.

-You are fairly well satisfied with what you are doing. (Only 20 per cent of women answering the questionnaires on which these data are based said "no.")

-You found your professors at M.I.T. a positive influence on your own career plans-but you thought the faculty might not have had that kind of influence on the career plans of fellow coeds.

-You found your parents and husband even more positive about your career

-You think that "being a woman" may have hampered your career development. (But one alumna explained that this was not because of her sex but because "I love my husband more than my career.") -You've experienced a "career discontinuity"-a change of status when you really didn't want one-most frequently

sponsibilities. -If you are asked for the one most important change needed in the structure of professional advancement in the U.S., you say acceptance of part-time work and study, for both men and women.

because of maternity and child care re-

-You think M.I.T.'s most urgent need with respect to women is more of them on the faculty; and the next most urgent need is for child care facilities and for relaxation of anti-nepotism rules.

-You also think there should be more women among the undergraduate and graduate students at M.I.T.

-But you suspect that "women do not belong in science and technology unless they are exceptionally motivated and gifted."

Readers may be surprised at the

source of that last comment: it comes -as do the others above-from 750 questionnaires returned by its members to the Association of M.I.T. Alumnae, a part of the Association's project to celebrate the 100th anniversary of the graduation of M.I.T.'s first coed (see July/ August, pp. 110-111). The response was from just under half of all the alumnae; the data come from an analysis by Susan L. Kannenberg, '61, Chairman of A.M.I.T.A.'s Survey Committee.

Just over two-thirds of the alumnae think that their career development has been hampered by their sex, and 18 per cent think the effect has been substantial. How? Here is the list, showing the number of times each factor was cited among 450 alumnae:

Subtle attitudes of discrimination Career or salary advancement 185 183 Obtaining a position Needing flexible work arrangements 93 Child care responsibilities 64 Marital responsibilities 55 22 **Educational opportunities**

A typical quotation, says Mrs. Kannen-. . . the main effects have been the psychological strain of having to deal with stereotyped attitudes about women. ... These problems seem to be diminishing as a result of both my own increasing competence . . . and the changing climate for women . . ."

Women Who Want More Women at M.I.T.: "We Invite Your Interest, Your Questions, and You"

If M.I.T. alumnae think there should be more coeds at M.I.T. (see above), let them be just a little bit patient.

... until, for example, Peter H. Richardson, '48, Director of Admissions, begins to hear from 10,000 high school juniors who scored well on preliminary College Board tests of scholastic aptitude which they took last year.

"You are one of a group of talented young women who can make significant contributions to the scientific and educational communities in the years ahead," Mr. Richardson wrote to all 10,000 of them. With his letter went a booklet called "A Place for Women"-a 32-page recruiting booklet developed and written by women at M.I.T. who want more women at M.I.T. "We invite your interest, your questions, and you," they say.

"Why not be a doctor, engineer, architect, mathematician, chemist, lawyer, politician? These professions have always had some women-but a tiny faction of the female population with an

aptitude for them. . .

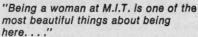
"We share a particular kind of educational experience . . . You will run into very few among the 8,000 undergraduate and graduate students and nearly 1,000 professors who don't share the view that all of us need a foundation in science and technology to understand most areas of life in our society, including politics, social problems, and the arts . . . You will find M.I.T. a center for continual intellectual and cultural activities. . . . Recent changes (show) the special democracy and intimacy of the M.I.T. community. For women and men, it is a place to study, work, and grow."











"If you're looking for equality, this is the place. Nobody is going to give you special treatment because you're a woman. If you want something, go work for it. "At least they can't call women here dumb broads"."

"There are as many ways of getting through M.I.T. as there are people here.

"If you're here, you know you're moderately smart, and so is everyone else. You won't either snow people with your brilliance or be regarded as different or strange because you're intelligent. It's taken for granted that you don't have to be perfect, either, or great at everythingif that were the case the Institute would be empty."

"Coed living is great. . . . The people in my living group are my closest friendsthe people I spend most of my time with, who influence my activities, course selection, and what I do in my spare time."

. . . all these are things that women students say about the life and times of an M.I.T. coed. They're quoted in a new booklet-from which also come the pictures on these pages-written by women at M.I.T. who want more women at M.I.T.; and copies have just been sent by Peter H. Richardson, '48, Director of Admissions, to 10,000 high school junior women who have scored well on College Board tests. (Photos: Ivan Massar and Margo Foote)





Women at M.I.T.:

A Debate on the Wellesley Exchange Becomes "a Lightning Rod for More Serious Problems"

For a five-year trial period beginning In 1968, M.I.T. and Wellesley students have been able to take courses in each other's schools, and during one of those five years about 25 students from each school lived on the campus of the other.

Continuation of the cross-registration program has now been approved by both schools, with a "thorough review" to be conducted in three years.

But the M.I.T. faculty has voted not to reinstate the M.I.T.-Wellesley Residence

Study of the issues was prolonged. The debate lead inevitably to the broader issue of M.I.T.'s role in the education of women. President Jerome B. Wiesner remarked to the faculty that debate on the M.I.T.-Wellesley programs is "a lightning

Wellesley-M.I.T.: An Assymetrical Exchange

rod for more serious problems."

M.I.T. has twice as many undergraduates as Wellesley has students. Yet in its report to the faculties of both institutions, the Joint Committee on the Exchange noted that "Wellesley interest in M.I.T. courses has almost always exceeded M.I.T. interest in Wellesley courses." A year ago, for example, Wellesley students applied to take a total of 510 places in courses at M.I.T. while M.I.T. students made only 214 applications for Wellesley courses. Twice in the five-year history of the exchange it has been necessary to limit the number of Wellesley participants.

Though the Committee's report offers no reasons for such an imbalance, several factors might contribute. M.I.T. curricula include many courses that bind M.I.T. students to the Institute campusespecially laboratory courses and re-search projects. M.I.T. students are also more bound to sequences of courses, some of which are not available every semester. And their schedules include more classroom instruction than is usual at Wellesley, so they have less freedom to commute to and from Wellesley. It has been taken as a guiding principle that cross-registration at one institution would not be allowed to exceed by more than 20 per cent the cross-registration at the other. Accordingly, the committee report notes, in 1972-73, "it was necessary to eliminate all Wellesley freshmen from the program and to limit most upperclasswomen at Wellesley to one course

Category (by department	Fall, 1	971-72	Spring, 1	971-72
or school—M.I.T.'s are in parentheses)	M.I.T. at Wellesley	Wellesley at M.I.T.	M.I.T. at Wellesley	Wellesley at M.I.T.
Humanities (Departments of Humanities and Philosophy)	117	99	143	110
Foreign languages (Department of Foreign Literatures and Linguistics)	17	20	21	16
Social Sciences (Departments of Economics, Political Science, and Psychology)	113	64	141	91
Science (School of Science)	12	79	24	44
(School of Architecture and Planning)	-	68		75
(School of Engineering)	44	19		22
Others	2	1	2	7

Figures for 1971-72 show that, under the Wellesley-M.I.T. cross-registration privilege, many M.I.T. students did go to Wellesley for courses in the liberal arts; but Wellesley students did not, in general, come to M.I.T. for science and engineering. Each course taken by each cross-registrant adds one to a number

somewhere on the chart. M.I.T.'s departments and schools are in parenthesis, Wellesley's are not; but Wellesley has no schools in architecture or engineering. In the "others" category, the Wellesley students came to M.I.T. for seminars, the M.I.T. students to Wellesley for physical education.

only . . ."

One might expect that M.I.T. students would pursue liberal arts at Wellesley, and Wellesley students might take science and engineering courses at M.I.T. Figures for 1971-72 (see chart) show that in that year, M.I.T. students did go to Wellesley to study liberal arts—but Wellesley students did not, for the most part, come to M.I.T. to learn the science and engineering which is not available at Wellesley. They chose M.I.T. courses in social sciences and humanities, forsaking engineering almost entirely, and showing their taste for science in biology, with a somewhat smaller appetite for mathematics.

All Wellesley students were asked late in 1972 about the M.I.T. programs; 45 per

cent responded; about half had taken M.I.T. courses in their own Wellesley majors. Their reasons: M.I.T.'s different educational approach, or sometimes the entirely different body of knowledge it teaches; for example, Wellesley teaches social psychology, M.I.T. teaches physiological psychology. Similarly, a combination of the two schools' resources provides a strong program in education and teacher certification. About 14 per cent of the respondents said they had used an M.I.T. science or engineering course to meet a requirement at Wellesley.

The final report on the exchange summarized Wellesley cross-registrants' reasons for coming to M.I.T. this way: "... The wider range of courses, a different, more quantitative, and techno-

logical approach to teaching . . . more relaxed attitudes toward deadlines, registration, class attendance, written assignments, final examinations, and grades. . . While these latter aspects are not unimportant in the educational process," the Joint Wellesley-M.I.T. Committee said, the Wellesley students seemed to feel "more emphasis at M.I.T. on learning rather than on meeting one particular instructor's expectations."

The obverse of this situation seemed to create some difficulties at Wellesley. Though "only one . . . faculty member among those consulted reported serious doubts about the program, several . . . had negative comments about the performance of M.I.T. students in their classes. Wellesley instructors have often found that they must have a different set of expectations for M.I.T. students." They cited such matters as "laxity . . . about . . . regular class attendance, written assignments, and deadlines for papers and examinations . . ."

What of M.I.T. students' view of Wellesley? After a survey of M.I.T. students, the Committee said that M.I.T. cross-registrants at Wellesley find "... an opportunity for a learning experience in an environment not pervaded by technology—that of a liberal arts college in which students' primary intellectual interests tend to be in the humanities and social sciences ... M.I.T. students [at Wellesley] ... are generally exposed to a liberal arts education and approach to learning without having to give up their M.I.T. identity."

No Room in the Houses

The immediate difficulty with the residence exchange-a plan by which some M.I.T. students could live at Wellesley and some Wellesley students at M.I.T .lies in M.I.T.'s overcrowded dormitory system. Half of the M.I.T. students who lived at Wellesley in 1970-71 came from M.I.T.'s fraternities. Their departure did not free campus living space for their counterparts from Wellesley, so the latter had no choice but to overcrowd McCormick Hall, the M.I.T. women's dormitory (available spaces in M.I.T.'s coed dorms were all taken by M.I.T.'s own women students). Overcrowding in all M.I.T. Houses could be an even bigger problem in 1973-

The Joint Committee on the Wellesley-M.I.T. Exchange and the administrators of the exchange at each school had recommended to the M.I.T. and Wellesley faculties that the residence exchange "be reinstated on a necessarily limited basis." But at M.I.T., the Committee on Educational Policy (C.E.P.), a standing committee of the faculty, voted the other way—and, on their recommendation, so did the faculty. Furthermore, the C.E.P. stipulated that "in any future residence exchange program, students from another institution must not be given priority in accommodation over bona fide M.I.T. students."

No Opportunity at All

The Joint Wellesley-M.I.T. Committee thinks that—on the M.I.T. side—"the most troubling response to the program is the serious opposition—even hostility—

which has been expressed by a significant number of women students at M.I.T. . . . We cannot dismiss or disregard the intensity of feeling which informs this dissent." This conclusion is based on a survey of M.I.T. coeds; it showed that, of the 35 per cent who returned questionnaires, only four women had ever taken any courses at Wellesley, only about 13 per cent had plans to take Wellesley courses, (in April, 1972, 37 per cent of all M.I.T. undergrads said they had such plans), and 55 per cent had "definite plans not to take courses" at Wellesley. The women's questionnaire produced 49 per cent in favor of the continuation of the cross-registration program, but 87 per cent of M.I.T. undergraduates had approved the program.

M.I.T. undergraduate women were asked: "For you personally, what is the primary kind of opportunity the M.I.T.? Wellesley exchange currently provides?" Respondents could put a check next to "expanded academic opportunities"; "expanded social opportunities (e.g. to make new friends, engage in different activities . . .)": or "a chance to experience a different college environment"; or they could use two blank lines for an individual response. Over 25 per cent of the respondents made use of those lines to give what turned out to be the most popular answer—the exchange "provided them with no opportunity at all," or words to that effect.

Agreeing with President Wiesner, the Exchange Committee concluded that the debate about the Exchange has "in some ways dramatized a series of unsolved problems in the experience of women at the Institute which clearly require close attention."

These became clearer when Emily L. Wick, Ph.D.'51, Professor of Food Chemistry, who was from 1965 until 1972 Associate Dean for Student Affairs with "primary responsibility for women students across the range of students affairs," spoke at a faculty meeting in March.

The Wellesley exchange, she agreed, was not in itself the problem. "We, the faculty and administration of M.I.T., are the problem," Professor Wick said. "We so very often, inadvertently to be sure, sell our women students down the river by acting as though they don't exist. We don't do this intentionally—quite the opposite; the goodness of our intentions only makes matters worse, and the state of being ignored is, therefore, all the more complete and bitter....

"All of us too frequently give the impression, both in written material that goes out from the Institute and in our daily conversation, that M.I.T. is designed to educate white males only. In this context, any women students on the scene are by definition Wellesley exchange students, here temporarily, and, therefore, not permanent-working-shoulder-to-shoulder serious members of our community. I'm willing to concede that that statement may be a bit extreme, but truly—this is the message that goes out to the community....

"At the moment, without intention on anyone's part anywhere, the Wellesley-M.I.T. exchange is working to the detriment of M.I.T. women students in terms of their belief in the Institute as a place of equal opportunity. Even more importantly, it works to the detriment of their belief in themselves and their ability to achieve their clearly held, high academic and professional aspirations."

And Professor Wick asked: "Why don't we turn this occasion of consideration of the Wellesley-M.I.T. exchange first into a resounding declaration of recommitment to the education of M.I.T. women as well as men? . . . At the next faculty meeting we can whole-heartedly vote full support first for our own students—both women and men—and then secondly for continuation of the Wellesley exchange, viewed in its proper perspective as a supportive rather than as, at present, a detrimental influence."

The Potential for Educating Women

The C.E.P. had prepared a statement "concerning the Education of Women at M.I.T." for the April faculty meeting, when the exchange would be voted upon. At that meeting, Professor Hartley Rodgers, Chairman of the Faculty and, ex officio. the C.E.P., asked for and received faculty endorsement of the statement, which indicated three ways to realize M.I.T.'s potential for educating women.

"... there must be more women faculty at both junior and senior levels," both to provide the "role models... necessary if women are to be encouraged to seek careers" and to have men (both faculty and students)... succeed in positions of responsibility. As the number of women in faculty positions increases, we hope (and expect) that their presence will be seen as natural rather than as exceptional."

"... there must be more women students. M.I.T. has a responsibility to educate those people whose talents can best be met by the Institute's resources... The largest untapped pool of qualified applicants are women... In addition, the expectations and experiences of all students at the Institute are left incomplete as long as a predominantly male atmosphere is maintained."

"... there must be efforts to correct the image of M.I.T. and of certain professions . . . as necessarily if not exclusively male."

One professor termed the statement "pious," and wondered what concrete steps could be taken. Professor Rodgers thought the problems could be divided into two sorts—though not without overlap: Those that might be amenable to "immediate, operational solution," including M.I.T.'s image and increasing the number of women applicants; and those that concern "what goes on in the classroom." (Asked for an example of the second type of problem, Professor Rodgers noted that studies at some universities have shown a bias against women in grading.) Solving this sort of problem will be much harder.

The C.E.P. promised that specific proposals for faculty consideration would be forthcoming at future meetings.

Responsibility for the Consequences of Research:

"What are we to do but try to get going?"

The American sat in a "large, mildewy room" in the Soviet Embassy in Tokyo.

"Well, Mr. initial A initial J Lewinter,

" 'Thirty-nine.'

" 'Address?'

" 'Cambridge, Massachusetts.

"Pogodin looked up. 'What do you do

in Cambridge?'

"'I'm an associate professor at M.I.T. and a specialist in ceramic engineering. For the last four years I've been working on ceramic nose cones for the MIRV

program.' ' The dialog is from a recent spy novel,

The Defection of A. J. Lewinter. In seeking the verisimilitude so desirable in this genre, the book's author, Robert Littell, a former editor at Newsweek, chose to have his scientist defect to the U.S.S.R. with trajectory equations for the MIRVthe Multiple Independently Targetable Reentry Vehicle-which allows a single missile to deliver several nuclear warheads, each to a different target. And he chose to make his scientist an M.I.T.

Though he did not read from it, Philip Morrison, an M.I.T. Professor of Physics, mentioned the book to his colleagues at a faculty meeting last May 16, to illustrate perhaps the least of the consequences of M.I.T.'s contributions to the nation's weaponry: a public image of the Institute as essentially a defense contractor. Professor Morrison's reference to the spy novel came as prelude to an afternoon of debate: the faculty was asked to conclude one committee's work-it had produced a report on the MIRV-and begin another's-a study of the feasability and desirability of faculty monitoring of research contracts.

Thus May 16th's debate was an episode in a history of debate on questions of ethics and conduct: To what extent must a researcher predict the consequences of his work? To what extent is this possible? Should his conduct be influenced by the forseeable consequences? Should a university's faculty make judgements or public pronouncements on national affairs? What responsibility does the faculty bear for the research a university conducts? Most basically, what should be the position of a university in American society?

While these questions range far beyond any specific research project, their embodiment at M.I.T. has been the MIRV. And it is with the MIRV that extensive examination of these questions by the faculty began.

The MIRV and M.I.T.

"MIRVing" was first proposed at the Pentagon in the early sixties. In one account, it began as merely an economy move, a way to conduct tests of three "reentry vehicles" (a treaty banning atmospheric testing of nuclear bombs had been signed in 1963) using only one missile. In another, it germinated as a weapon to overcome an enemy's Anti-Ballistic-Missile (A.B.M.) defense systems.

Its potential was soon appreciated. The first operational MIRV systems were the Navy's Poseidon C-3 and the Air Force's Minuteman A-3. M.I.T.'s Instrumentation Laboratory was the sole contractor for the development of the hardware and software of the Poseidon's guidance system; the first contract was signed in the second half of 1965. The Minuteman A-3 used a guidance system developed by the Autonetics Division of North American Aviation, now Rockwell International; that system used acceleration sensors developed by the I-Labs. The Minuteman A-3 was operational a few months before the Poseidon C-3.

In 1967, the public began to hear of "MIRVing." In November of 1969, a few hundred demonstrators, drawn from M.I.T. and the Boston area, obstructed the entrances of two adjoining buildings of the I-Labs near the M.I.T. campus, until driven off by police. In May of 1970, in the wake of the American invasion of Cambodia, and the deaths at Kent State University and Jackson State University, the M.I.T. faculty met to vote on special procedures to end the academic year. At M.I.T., as at hundreds of other universities, academic work had been virtually halted by a student strike. At that meeting, Professor Morrison proposed, and a majority of the faculty agreed, that a faculty committee should be created to study three issues: Would the MIRV set off another upward spiral in the arms race?; Were there other conceivable weapons which could set off a spiral in the arms race?; and Were there any appropriate actions concerning weapons development which might be taken by M.I.T.'s faculty?

Stability from Assured Destruction

In broad terms, the nuclear diplomacy theorists hold that there are two paths to security:

-A nation is secure if its defenses can limit the destruction caused by an enemy's weapons to an "acceptable" level. Implementing this philosophy is widely held to be impossible or too expensive. The first phase of the Strategic Arms Limitation Talks (S.A.L.T.) between the U.S. and the U.S.S.R. produced an agreement to limit A.B.M.s; perhaps the philosophy of limiting damage has been abandoned, or perhaps only unworkable technology.

-A nation is secure if its offenses are strong enough to overcome an enemy's defenses, and inflict a level of damage that is "unacceptable" to them. But if a nation knows that its offenses can destroy an enemy's capacity to retaliate. this is called "first-strike capability," and it is "destabilizing," because it encourages that nation to launch a "pre-emptive strike." Thus each nation must have "second-strike capability": If each side in a war can inflict unacceptable secondstrike damage on the other, there is, says the theory, stability.

"Acceptable" and "unacceptable" levels of destruction are the subjects of debates in government, the military, the think tanks, and the political science departments of universities. But national security is not quantifiable. "Some instabilities are no less real for being rooted in suspicion and fear instead of hard fact," wrote John Newhouse in his recent book, Cold Dawn: The Story of SALT. "What is stabilizing for one sidesomething it is doing-may seem wildly destabilizing to the other. . .

The Report on MIRV

The faculty MIRV committee's tenure was a difficult one. "The President [M.I.T. President Howard W. Johnson] had a fair amount of difficulty breathing life into such a committee," Jerome B. Wiesner, current President of the Institute, told the Faculty in February, 1973. Five professors initially served: W. W. Kaufmann (Political Science), Rene Miller (Head of Aeronautics and Astronautics), George (Political Science), Weinberg (Physics), and Robert Solow (Economics), chairman of the committee, who resigned in the spring of 1972. Reduced to four, the committee continued its work, with Professor Rathjens as its chairman.

The committee reported to the faculty

in February, 1973—two years and nine months after the faculty vote that had authorized its existence. Here are the committee's conclusions:

I. Is the prima facie case made against the high-accuracy MIRV as destabilizing

The report's discussion of its first question is best described as complex. Accurate and reliable "MIRVed" missiles, the committee decided, could destroy a large missile force. But unless the capability to destroy an enemy's other weapons was simultaneously developed, there would be no increased threat of an attempted preemptive strike. "MIRVed" missiles, however, might make it more likely that a nation would try to destroy a limited number of its adversary's missiles: and "MIRVed" missiles also make it more likely that escalation would follow such an attempt. Missiles that survived a first strike would be more effective retaliatory weapons if they were "MIRVed." "MIRVed" missiles have eroded confidence in silo-based missiles, and might encourage efforts to find new sorts of weapons. Yet refining MIRVs should not further weaken what confidence is left in A.B.M. systems. .

The report concluded that "MIRVs are in some respects stabilizing and in other respects destabilizing." Deciding which it is, added Professor Rathjens, "depends in some degree on what you mean by destabilizing..."

II. Are there other weapons systems forseeable in the near future which present a similar hazard?

"We ducked that, frankly," Professor

Rathjens told the faculty.

The committee report "regrets that it has not been possible for us to analyze other forseeable weapons systems as to their potentially destabilizing effects. Consideration of some potential development, e.g. as regards anti-submarine warfare, leads us to believe that any analysis would be at least as complex as that regarding MIRVs."

III. Are there actions which the faculty should take in this matter in the national

interest?

"Here," said Professor Rathjens, "the

committee begged off, too. . ."

The Committee's report concluded that the issue in this third of its questions was "not weapons technology or its implications but rather whether a university faculty should take a position on such an issue as the national decision to develop MIRVs."

"We probably each have our individual views on that," said Professor Rathjens, "but we didn't feel that we were especially qualified to give you a recommendation..."

The report's final paragraph: "While we may have a better understanding of the implications of MIRV development as a result of our deliberations, we feel no more qualified to recommend faculty action—or inaction—than we did a year and a half ago; and accordingly have no recommendation to make."

"... There might be something the faculty could do."

The committee having reported to the faculty, there would normally be a vote to

accept the report. This time, acceptance was not routine.

After commenting that "the committee under Professor Rathiens has done a detailed and scrupulous job presenting the complex case," Professor Morrison turned to the question of faculty action. "I still feel," he said, "that in spite of the committee's evident reluctance to close the main question that was set them, there is a question. . . . The fact is that the MIRV project in large measure was done at M.I.T., under the [M.I.T.] Corporation, with, I think, either no, or at least only tacit, faculty approval. And I think that's a situation which on the whole does not bode well for the state of the polity if it continues on most issues for a very long time."

The MIRV is a bad issue upon which to center debate on faculty control of research projects, because "it's so moot and so complex and so subtle and so old. . ." said Professor Morrison. "I would, however, like to speak against the acceptance of the report at this faculty meeting. It seems to me only fair that after two years and nine months . . this report . . . should be allowed at least one month to ferment away a little bit . . . for all people who wish to say that there might be something the faculty could do."

Earlier in the meeting, Professor Rathjens had expressed a desire to the faculty: "Speaking for myself, and, I trust, for other members of the committee, we would like at this point to be discharged."

Now, Professor Joseph Licklider (Electrical Engineering) made a suggestion. "I think," he said, "we can solve Professor Morrison's problem and also the committee's if we 'receive' the report rather than 'accept' it..."

Professor Morrison agreed. "Certainly, the 'receipt' of the report is objectively the case."

President Wiesner accordingly asked for a motion "that the report be received and the committee dismissed."

After a warning from Professor Hartley Rodgers, Jr. (Mathematics), Chairman of the Faculty, that agendas of future faculty meetings were already crowded without adding items resulting from this matter, the faculty so voted.

Professor Rodgers proved to be right; three months passed before discussion

of this issue could resume.

"... the real interest of our national security"

At a May 16 faculty meeting, Professor Morrison spoke for a motion (by himself and Associate Professor of Humanities William Watson) "to accept the [Rathjens committee] report and to forward it to the [M.I.T.] Corporation with . . . two formal comments . . ." which, Professor Morrison told the faculty, "I hope are less contentious than those we made a few years ago. . ."

"These comments," copies of the motion distributed at the meeting added parenthetically, "are occasioned by the central place the special laboratories of M.I.T. have taken in the development of the re-entry and guidance technologies which alone make high-accuracy MIRV forseeable."

"That parenthetical expression," Professor Morrison said, "is, I believe, the heart of the matter." While it was wise for the M.I.T. faculty to avoid making pronouncements on foreign policy, M.I.T.'s name is "stamped" on the technology of the MIRV. "We were not engaging in something for which we have no responsibility."

The comments, as originally written in the Morrison-Watson motion, are these: Comment 1: This study on MIRV does not attempt to express an opinion by the faculty on the wider issues of the arms race, but it does make clear that not all weapons systems which M.I.T. might have the capabilities to develop are in the real interest of our national security.

Comment 2: Faculty responsibility may properly extend to a prudent judgement of the forseeable consequences of M.I.T. research and development.

At first, the debate concentrated on Comment 1.

"To think that M.I.T. has the capability to develop a weapons system [is] at least imprecise," said Walter Rosenblith, Provost and Professor of Communications Biophysics. Professor Roy Kaplow (Metallurgy) agreed: M.I.T. cannot develop a weapons system, he said; rather, it contributes to a national decision.

The specific question of whether the Instrumentation Laboratories could have 'developed" the MIRV is answered negatively by the president of the Charles Stark Draper Laboratories, Brigadier General (Ret.) Robert A. Duffy. He told Technology Review that after C. Stark Draper, founder of the Instrumentation Laboratories (which are now named after him and are independent from M.I.T.; see page 83), conceived the idea of inertial quidance and built the first acceleration sensors, no one was indispensable. And by the time inertial guidance came of age, its military applications demanded more than any single laboratory's resources. The Air Force and Navy MIRV guidance development projects went to different contractors; and those contractors "developed" the guidance systems, but could not themselves manufacture those systems, or other components of "MIRVed" weapons.

The concept of inertial guidance, like many other concepts in the history of science and technology, seems to be one that, when its time came, sprouted in many soils. Germany had the concept toward the end of World War II, but, the U.S. learned after the war, lacked the hardware. Russia would need "something that was conceptually close" to develop intercontinental ballistic missiles. In August, U.S. Secretary to Defense James A. Slesinger announced that the Soviet Union had tested a MIRV, though whether it is indeed a MIRV rather than an MRV-whose warheads simply scatter like buckshot-is uncertain to some physicists, who wonder whether surveillance-just watching a test, perhaps by satellite reconnaissance-can tell the difference.

Returning to the May 16 faculty meeting: The specific words in Comment 1 that caused the difficulty were: "all weapons systems which M.I.T. might have the capabilities to develop." Faculty meetings

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are often remarkable for the considerable communal editing that motions may undergo before they are voted upon; if these editings are taken to be "friendly amendments," the suggested changes can be made in the original motion without need of a vote on each change.

There were a wealth of suggested replacements for the bad phrase in Com-"All weapons systems or parts ment 1: thereof," "all weapons systems to which M.I.T. might contribute," "all weapons systems or subsystems," "all essential components" ("Like gasoline in airplanes?" asked Albert G. Hill, M.I.T. Vice President for Research, Chairman of the Board of Directors of the Draper Labs, and Professor of Physics.).

The final choice: "All weapons systems to the development of which M.I.T. might substantially contribute."

"... a prudent judgement of the consequences. . .

The disaffection with Comment 2 was deeper.

"I would hesitate," said Professor Peter Elias (Electrical Engineering), "to commit us to exploring all the consequences of our actions." While "a step in that direction" is important, demanding complete cognizance would "impose a burden on the faculty that it couldn't keep." Professor Elias was not sure that more than weapons projects, human experimentation, and M.I.T.'s off-campus Lincoln Laboratory should be examined.

Professor Bernard Burke (Physics) felt that "Comment 2 is a little gratuitous. . . While "some [projects] are obviously bad," others are merely "trivial," and the problem of distinguishing "that which is significant from that which is trivial" is hidden by Comment 2.

Arguing for Comment 2, Professor Nathan Sivin (Humanities) accepted its "ambiguity." The "import" of the comment, he said, was that "there is nothing improper in making a judgement . . . in cases where one can see the consequences."

Professor Rosenblith told the faculty that while he agreed that ambiguity in Comment 2 was proper, he preferred the word "concern" to the word "judgement" used in the motion.

Frisch Professor David (Physics) pointed out that substituting "concern" for "judgement" would make Comment 2 read this way: "... faculty responsibility may properly extend to prudent conthus producing the unfortunate implication that "concern" is a feeling the faculty arrives at only in the most extraordinary circumstances.

At about this point, Professor Louis Smullin (head of Electrical Engineering) said that he liked all the proposed wordings, and therefore wished to call the question as originally worded.

Parliamentary procedure requires a two-thirds vote to call a question. The vote was taken: 49 were in favor, and Dr. Wiesner did not announce the small number opposed (at this writing, the minutes of the meeting kept by the secretary of the faculty are not yet available.).

Clarification was required that the coming vote would be on acceptance of the motion as written, with the sole exception of one amendation to Comment 1: weapons would be those "to the development of which M.I.T. might substantially contribute." The vote then took place; the motion passed, 44 to 31. (It might be noted that the faculty numbers well over 900; attendance at faculty meetings is invariably poor.)

Professor Rosenblith told the faculty that he would have voted for the motion

if it had been more polished.

"What am I to do but try to get going?"

One motion remained at the May 16 faculty meeting, a motion offered by five professors: Morrison and Watson, and Eugene Bell (Biology), Bernard Feld (Physics), and David Frisch (Physics).

"We believe," said this motion, that "a systematic procedure is needed for the faculty to accept some continuing responsibility-neither an all-inclusive nor an all-ignoring one-for the effects of the research and development carried out on campus . . . The matter is evidently complex, and it will be useful to consider a variety of options and to learn what other universities have done. We therefore move (i) that an ad hoc committee of the faculty be appointed to study this proposal for a standing committee on grant and contract assessment, and (ii) that it be charged to report to the faculty during the spring term of 1974."

The motion added that if only contracts greater than \$100,000 in size were examined, such a standing committee's work would consist of examining about 60 new contracts each year. Professor Frisch, speaking for the motion, added that the Massachusetts General Hospital had just inaugurated such a committee, and had coincidentally decided to use a

\$100,000 cutoff.

The faculty discussion began with a bout of communal editing. Within moments, suggestions had been made of "proposals" instead of "this proposal," then "the question of a standing faculty committee," "the need for a standing faculty committee"...

"Whaddaya want, Frisch?" asked Dr. Wiesner.

"I'm not quick enough on my feet to choose between all these lovely things," said Professor Frisch.

Then there were questions on what the nature of the standing committee might be. Dr. Wiesner responded that there were many possibilities: screening committees, sampling committees, watchdog committees, but that he took the motion to mean that "what we want to do is uncertain enough so that some group of the faculty must talk it out."

Professor Burke wished to know the criterion for the \$100,000 cutoff.

"None," said Professor Frisch. "I know the subject is very difficult," he added, "but what are we to do? I'm conservative, systematic. What am I to do but try to get going?"

Professor Louis L. Bucciarelli, (Aeronautics and Astronautics) asked that the mention of a "standing committee" be expunged from the motion, leaving an ad hoc committee to study grant and contract assessment. He also asked that any interested faculty members be allowed to serve on this ad hoc committee. In this, he was dissuaded, but his desire to drop consideration of the possibility of a standing (that is, permanent) committee came to a vote as an amend-

ment, and was defeated.

Professor Burke spoke again, first on the \$100,000 cutoff. "Your criterion," he said, "seems about 20 years out of date." We might first "study whether \$100,000 is worth anything anymore." He then spoke of his own work in radio astronomy. One possible outcome of this work, he said, could be realization that there is other intelligent life in the universe. This could have a stunning impact on humanity. Was some committee to debate this when his research grants came up?

Professor Frisch concluded briefly. "We have never worked for Moscow or The Committee for the Reelection of the

President," he said.

The question was called. It carried, 40 to 27. Accordingly, the President was

to form a faculty committee.

But doing so during the summer is apparently impossible. More than four months have passed—a considerable amount of time, but not, says Dr. Wiesner, an unusual delay in appointing the members of a faculty committee. It is possible that the membership will be announced at the faculty's scheduled meeting in October. The committee is still to report to the faculty in the spring.

Some New Records (Ho Hum) by "the People Who Know Us Best and Care the Most"

New fund-raising records ought to be news. But how does an editor make news out of something that happily happens every year?

The point is that the M.I.T. Alumni Fund has done it again: \$3,183,680 in 1972-73, a new all-time dollar record for the Fund, 14 per cent ahead of the pre-

vious year's record \$2.8 million.

In the Fund's annual report, now on the way to nearly 50,000 alumni, Howard O. McMahon, Ph.D.'41, Chairman of the Alumni Fund Board in 1972-73, says the record "is a most gratifying vote of confidence in M.I.T. by . . . the people who know the Institute best and care the most."

The 1972-73 total of 21,796 donors is just short of last year's record 22,067. But look at these figures, just compiled by Frederick G. Lehmann, '51, Director of the Fund:

-Over 2,800 Alumni Fund contributors in 1972-73 gave \$100 or more.

-One-third of all 1972-73 contributors gave more than their last gift.

-Nearly 1,200 1972-73 contributors gave for the first time ever.

Other records during the year, too:

-Some 820 alumni participated in telethons-calling classmates or neighbors to urge them to give to the Fund. They talked to 9,847 alumni, of whom 6,244 pledged to give-a 63 per cent pledge rate. The redemption rate, overall: 70 per cent. More alumni were talked to by fellow-alumni in the interest of the Fund, and more gave money as a result of telethon activity, than ever before.

—A record 273 companies matched a

record 1,780 alumni employees' gifts with \$158,110-a record, too.

-Some 850 alumni-more than ever before-have notified M.I.T. of plans for future gifts, mostly through wills and estate planning.

And then of course, there is the stunning \$8,106,195 reunion gift of the Class of 1923 announced on Alumni Day-a record of such proportions that it may well become a permanent higher water mark in at least the 20th century.

But don't forget the Class of 1971: it's unique distinction is having oversubscribed its second \$100,000 endowment fund during the year. Both funds provide annual gifts-the first fund this year put \$5,300 into the Alumni Fund, the new one made available over \$4,000 for scholarships.

Here are the top ten classes in percentage participation in the 1972-73 Alumni Fund:

1911	Oswald W. Stewart, Agent	68%
1901	Edward H. Davis, Agent	67
1913	Ellis W. Brewster, Agent	66
1927	Richard P. Hawkins, Agent; William L. Taggart, Estate Secretary; Harold	62
	W. Fisher, Reunion Gift Chairman	
1933	Robert H. White, Agent; Ellis W. Litt- man, Estate Secretary and Reunion	59
	Gift Chairman	
1923		58
	Coleman, Estate Secretary; David W. Skinner, Reunion Gift Chairman	
1928	Charles E. Worthen, Agent	58
1937	John H. Fellouris, Agent; George S. DeArment, Estate Secretary; G. Rich-	54
	ard Young, Reunion Gift Chairman	
1966		54
1934		
	Mills, Estate Secretary; Frank R. Milliken, Reunion Gift Chairman	
	Willikell, Neullon Gill Chairman	

And here are the totals of Alumni Fund giving from the ten leading classes and courses:

1923	\$221,958
1948	164,644
1926	152,401
1951	144,886
1925	133,376
1947	126,757
Chemical Engineering	100,846
1935	96,930
1949	86,020
1928	82,452

As the 1973 Fund report was released. Mr. Lehmann announced the names of six new members joining the Alumni Fund Board in time to supervise the 1974 Fund solicitation. They are Russell L. Haden, '40, Ralph Landau, Sc.D.'41, Norman B. Leventhal, '38, Marjorie Pierce, '22, Samuel R. Spiker, '25, and Edward O. Vetter,

Individuals Noteworthy

In order to devote more time to M.I.T. affairs, Howard W. Johnson, Chairman of the Corporation, has chosen not to stand for re-election as Vice Chairman of the Board of Directors of Federated Department Stores, Inc. He will continue as a member of Federated's Board of Directors and as a consultant to the company. Mr. Johnson has also been named to a three-year term as Chairman of the Environmental Studies Board of the National Academy of Sciences and the National Academy of Engineering.

Vincent A. Fulmer, S.M.'53, has taken a "part-time leave of absence" from M.I.T.

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to be Administrative Vice President of William Underwood Co., Watertown, Mass. He'll continue as Secretary of the Institute to work with the M.I.T. Corporation and Visiting Committees, and as a member of the Faculty Council.

Awards and Honors

Manoug M. Ansour, '73, has won a Winston Churchill Foundation Scholarship as one of the nation's outstanding students in engineering, mathematics and science. . . Victor P. Ardito, '56, was recently honored by the American Iron and Steel Institute for excellence on two papers he co-authored for technical meetings of

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A.I.S.I. . . . C. Gordon Bell, '56, a leader in the development of the minicomputer, received Carnegie-Mellon University's Institute Award for 1973. . . . Richard C. Bradt, '60, was presented the Matthew J. and Anne C. Wilson Outstanding Teaching Awards in the College of Earth and Mineral Sciences, Pennsylvania State University. . . . Stephen H. Feairheller, Ph.D.'64, received the Alsop Award of the American Leather Chemists Association for his leadership in building plastics into the structure of leather. . . . John T. Frankle, '58, and Josef Gross, S.M.'56, were awarded the 1973 David Sarnoff Award of their Outstanding Technical Achievements at R.C.A. . . . Forrest W. Getzen, Ph.D.'56, has been awarded a top honor by the North Carolina Institute of Chemists for professional and scholarly leadership. . . . Frederic C. Jelen, '31, received a Guest Speaker's Bureau Award from the American Association of Cost Engineers.

Julian A. Joffe, '24, has been named a member of Delta Tau Kappa, the International Social Science Honor Society, in recognition of his outstanding contribution to studies in the history of civiliza-. G. Robert Keepin, '47, was named winner of the American Nuclear Society Special Award for 1973. . . . Warren K. Lewis, '05, Emeritus Professor and Lecturer at M.I.T., was named the recipient of the National Academy of Engineering's Founders Medal for his development of an improved system for handling heterogeneous reactions between gases and solids and for his contributions to engineering education. . . . Harold S. Mickley, Sc.D.'46, received the Alumni Distinguished Service Awards from the California Institute of Technology. . . . Charles L. Norton, Jr., '25, was granted the American Society for Testing Materials' Award of Merit and named a Fellow of the Society. . . . Norman W. Ryan, Sc.D.'49, was a recipient of the 1973-74 Distinguished Research Professorship of the University of Utah. . . Frederick Sargent, 2nd, '42, Professor of Human Ecology at the University of Texas School of Public Health, has been selected one of the outstanding graduates of Boston University School of Medicine during the last half century. . . . Charles V. Smith, Ph.D.'68, has been named the nation's top young engineering teacher of 1972 by Eta Kappa Nu, Electrical Engineering Honor Society, University of Texas at Austin. . . . Harold C. Teubner, S.M.'51, has been awarded the General Bunker Award as the outstanding Defense Manager in the Air Force during 1972. . . . Herbert S. Waxman, '58, was one of six Temple University faculty members cited for distinguished teaching.

James D. Bjorken, '56; Felix E. Browder, '46; Albert M. Clogston, '38; James F. Gilbert, '53; Lawrence R. Klein, Ph.D.'44; and James R. MacDonald, '44, were elected to membership in the National Academy of Sciences.

Solomon J. Buchsbaum, Ph.D.'57; Robert H. Cannon, Jr., Sc.D.'50; Robert M. Fano, '41; Arthur E. Humphrey, S.M.'60; H. Richard Johnson, Ph.D.'52; Thomas MacMaster Leps, S.M.'39; Robert W. Mann, '50; Stewart E. Miller, '40; Theodore J. Nagel, S.E.'61; Henry A. Schade, S.M.'28; Ivan E. Sutherland, Ph.D.'63; Howard S. Turner, Ph.D.'36; and Lotfi A. Zadeh, S.M.'46, have been elected to membership in the National Academy of Engineering.

Professional Societies

S. L. Blum, Sc.D.'54, has been appointed Chairman of the National Materials Advisory Board. . . . Henry Cohen, M.C.P.'44, has been elected Chairman of the Council of University Institutes for Urban Affairs. . . . Lowell L. Fellinger, Sc.D.'41, E. Morse Blue, '37, and Robert L. Mitchell, S.M.'47, have been elected Fellows of the American Institute of Chemical Engineers. . . . Dean B. Harrington, '44, has been elected a Fellow of the Institute of Electrical and Electronics Engineers.

Ralph Landau, Sc.D.'41, was elected to the Council of the National Academy of Engineering. . . . John L. Lawson, S.M.'31, has been elected to a three-year term on the Board of Directors of the National Council of Teachers of Mathematics. . . Nathan E. Promisel, S.M.'29, was granted Honorary Membership in the American Society for Testing and Materials. . . Robert C. Seamans, Jr., Sc.D.'42, has taken office as President of the National Academy of Engineering. . . . Herbert H. Uhlig, Ph.D.'32, has been named President of the Thoreau Society for 1973-74.

University Appointments

To the Faculty of Harvard Medical School: Joseph Eichberg, '57, to Associate Professor of Biological Chemistry and Robert D. Rosenberg, Ph.D.'69, to Assistant Professor of Medicine. . Nicholas Baloff, S.M.'60, has been appointed Dean of the College of Business Administration, University of Oklahoma. William R. Bergmark, Ph.D.'67, to Full Professor in the Department of Chemistry, Ithaca College. . . . R. Clay Burchell, '50, to Clinical Professor in the Division of Health Sciences, University of Vermont. . . . Simone Clemhout, Ph.D.'63. to Associate Professor in the Department Consumer Economics and Public Policy at the N.Y. State College of Human Ecology, Cornell University. . . . David Mintzer, '45, has been elected Vice President for Research and Dean of Science, Northwestern University. . . . Nathan Sloan, M.P.H.'43, has been appointed a Visiting Scientist, engaged in the study of chromatography, Harvard University. . . . Ralph Warburton, '57, has been named Associate Dean of the School of Engineering and Environmental Design, University of Miami.

Special Appointments

James C. Allison, Jr., Assistant to the President and Chancellor for Minority Affairs at M.I.T., has been elected to the Board of Directors of the Lewis H. Latimer Foundation, established in 1972 to provide supportive and technical assistance to minority businessmen. . . Carroll W. Boyce, '44, has been appointed Editor-in-Chief of Fleet Owner, a monthly magazine for administrative, operating and maintenance managers of motor vehicle fleets. . . . Conrad M. Drescher,

S.M.'71, has been assigned as an American Consul at the United States Consulate General in Guadalajara. . . . George B. Field, '51, has been named Director of the new Center of Astrophysics created to coordinate related research activities of the Harvard College Observatory and the Smithsonian Astrophysical Observatory. . . . Jack Frailey, '44, veteran light-weight crew coach at M.I.T., has been elected Chairman of the U.S. Olympic Rowing Committee. . . . William J. Hecht, '61, has been named Chairman of the 1973-74 Massachusetts State Science . Russell C. Kidder, '53, has been elected Secretary for the year 1973-74 of the Chemical Marketing Research Association. . . . Gordon H. Pettengill, '48, M.I.T. Professor of Earth and Planetary Sciences, is one of 22 scientists selected by N.A.S.A. to develop experiments for a 1978 space probe to Venus; Dr. Pettengill has been named Chairman of the Radio Science Committee, which will develop methods of using long-baseline interferometry to study the wind profile of the Venusian atmosphere. . . Michael Price, '69, will leave soon for the Middle East, representing the American Friends Service Committee, to study the feasibility of an A.F.S. project in East Jerusalem. . . . Merton Dick Van Orden, U.S.N., '49, has assumed the post of Chief of Naval Research. . Wolfe, '19, has been named a founding member of a newly formed group of advisors to the Rockefeller University, established in 1901 as the United States' first biomedical research center and now one of the world's few graduate universities in the sciences.

John M. Nalle, 1897-1973

John M. Nalle, S.M.'20, of Charlottesville, Va., who was Assistant Placement Officer at M.I.T. from 1933 to 1937, died at West Point, N.Y., on July 23; he was

Mr. and Mrs. Nalle were on a vacation trip at the time of Mr. Nalle's death; they had lived in Belmont, Mass., during and after his service in the Placement Office at M.I.T. until moving to Virginia upon Mr. Nalle's retirement. He was a graduate of the University of Virginia School of Engineering (1919) and obtained his M.I.T. degree in the Department of Electrical Engineering.

Robert L. Hershey, 1902-1973

Robert L. Hershey, '23, who taught chemical engineering at M.I.T. for 12 years before joining E. i. du Pont de Nemours and Co. in 1936, died in West Chester, Pa., on June 19; he was 71.

Dr. Hershey was a Director of the du Pont Co. at the time of his death; he had been Vice President and a member of its Executive Committee from 1958 until his retirement in 1966; earlier assignments had been in research and later management for the Ammonia Department of du Pont's Experimental Station.

Dr. Hershey's teaching career at .I.T. paralleled graduate study here; he received the S.M. in 1924 and the Sc.D. in 1935, both from the Department

of Chemical Engineering; thereafter he was for one year Director of the Buffalo Station of the School of Chemical Engineering Practice-at the Lackawanna (N.Y.) Works of Bethlehem Steel Co.

Lan J. Chu, 1914-1973

Lan J. Chu, Ph. D. '38, a distinguished contributor to electromagnetic theory who was Webster Professor of Electrical Engineering, died on July 25 after a brief illness; he was 59.

Professor Chu first came to M.I.T. in 1934, upon completing his under-graduate studies at Chiao Tung University, Shanghai; he was a native of Kiangsu Province, China. He continued at M.I.T.-in the Radiation Laboratory and later the Research Laboratory of Electronics-following completion of graduate degrees in the Department of Electrical Engineering, and he joined the faculty as Associate Professor in 1947.

A gifted teacher, Professor Chu had a leading part in modernizing the curriculum in electrical engineering in the late 1950's. He was also known for contributions in antenna design, the theory of interaction between waves and moving, polarizable matter, and the theory of microwave tubes.

Professor Chu's appointment as Edwin Sibley Webster Professor of Electrical Engineering in 1963 recognized his leadership in both teaching and research; he had been made Professor of Electrical Engineering in 1952.

Most recently he has been on leave from M.I.T. during the spring term of each year to teach at his alma mater, now located in Taiwan, and to assist in its development of graduate education. He was also the founder and an active participant in Chu Associates, Harvard, Mass., a firm specializing in the design and manufacture of microwave and high-frequency radio antennas.

Charles M. Wareham, 1892-1973

Charles M. Wareham, '16, Associate Professor of Inorganic Chemistry Emeritus, died on July 26; he was 81.

Professor Wareham joined the M.I.T. staff in 1917, just a year after receiving his bachelor's degree in sanitary engineering, to be a teaching assistant in drawing and design geometry; two years later he joined the Chemistry Department, where he became Associate Professor in 1941 and from which he retired in 1957.

Max I. Alimansky, 1906-1973

Max I. Alimansky, '28, who had been active in alumni affairs during 44 years' service with General Electric Co., died in Pittsfield, Mass., on July 29; he was

Mr. Alimansky joined G.E. upon receiving his master's degree in electrical engineering from M.I.T. in 1929; he served in sales, engineering, and management posts in a number of G.E. departments and divisions, and most recently-before his retirement in 1972had been responsible for organizing technology for developing new and im-

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Active in both the M.I.T. Club of Pittsfield and the M.I.T. Alumni Fund, Mr. Alimansky was some years a member of the Visiting Committee to the Department of Electrical Engineering. Upon his death friends and family established in his memory a scholarship foundation to provide financial aid for qualified M.I.T. undergraduates from the Pittsfield area, to which contributions are invited; they should be sent in care of James O. Sweeny, 11 Willow Lane, Pittsfield, Mass., 01201.

Deceased

Walter O. Pennell, '96, June 8, 1973* Frederick W. Grover, '99, January 30,

John Foote Norton, '06, June 27, 1973* Eleanor Manning O'Connor, '06, July 12, 1973*

Rufus C. Folsom, '08, July 19, 1973* George W. Sheldon, '10, April 14, 1973 George M. Sprowls, '12, June 25, 1973* Manuel Font, '13, June 11, 1973 Arthur W. Johnson, '14, July 26, 1973 William L. McPherrin, '14, July 12, 1973 Charles M. Wareham, '16, July 24, 1973 Harold M. Brayton, '17, April 23, 1973 Carl A. Lindgren, Jr., '18, July 31, 1973 Walter R. Russert, '18, November 19, 1970

C. Ellsworth Brown, '20, July 23, 1973 Arthur C. Miles, '20, December 19, 1972 Willard G. Loesch, '21, June 18, 1973* Edwin A. Gruppe, '22, July 2, 1973 Edward Masterson, '22, May 3, 1972 James R. Maxwell, Jr., '22, June 1973 Norman T. Allen, '23, May 1973 Gerard Bayce, '23, December 14, 1972 Robert L. Hershey, '23, June 20, 1973* Jack D. Preston, '23, April 2, 1973 Griffin Crafts, '24, August 6, 1973 Ellis O. Jones '24, June 17, 1973 C. Minot Fogg, '25, January 15, 1970 Hoyt S. Griffith, '25, November 6, 1971 Roger Griswold, '25, June 9, 1973 George W. MacDuff, '25, April 3, 1972 William C. Noell, '25, September 28, 1970 Edwin C. Ewald, '26, June 24, 1973 Cecil C. Ogren, '26, June 19, 1973* Malcolm Graham, '27, January 3, 1973* James K. Small, '27, June 2, 1973* Donald H. Spitzle, '27, August 1969 Max I. Alimansky, '28, July 27, 1973 Stewart M. Davis, '31, March 10, 1973 Gordon D. Shellard, '31, July 13, 1973* William Liben, '32, November 11, 1972 Elton N. Roberts, '33, May 20, 1973 Joseph F. Pepi, '34, March 7, 1967 Lan J. Chu, '35, July 25, 1973 James F. Notman, '35, July 24, 1973 Charles S. Symonds, '35, October 17, Brewster H. Gere, '38, July 16, 1973

Kenneth C. Vincent, '43, February 26,

Charles E. Arnold, '44, August 18, 1973 Edmund T. Sztramski, '44, June 21, 1972 Kennett W. Patrick, '46, July 26, 1973 David R. Batson, '48, January 23, 1973 Basil T. Barber, '50, January 1972 Anthony L. Julius, '50, August 7, 1970 Robert L. Burkholder, '58, October 28,

E. Wardwell Stone, '59, May 31, 1973 Joseph R.A. Strutt, '62, August 8, 1973 *Further information in Class Review

Class Review

96

Congratulations will be due Dr. William D. Coolidge on October 23 when he will celebrate his one hundredth birthday. When I called on him in the summer he was anticipating a visit from his son and a trip to his Adirondack cabin. Dr. Will continues his gathering of honors and carries on a lively correspondence with M.I.T.'s oldest graduate, Mrs. Caroline Whitney Barrett '94.

We regret to report the death of classmate, Walter O. Pennell, Course VI, on June 8 in Exeter, New Hampshire. After graduation he taught at LaFayette College for two years and then joined the Bell Telephone Co., of Philadelphia. From 1898 until his retirement in 1941 Mr. Pennell held various positions in which he planned and supervised the erection of telephone plants in many states of the Union. In addition to many papers on math and electricity he was the originator of several patents of widely used telephone devices. After retirement he was active in many civic organizations and served in the New Hampshire state legislature. He had one son and four daughters, one of whom, Martha M. was a member of the Class of 1960 .- Clare Driscoll, Acting Secretary 2032 Belmont Rd. N.W. Washington, D.C. 20009

98

During the summer **Bob Lacy** was at his cottage on Squirrel Island in Maine. On Nov. 13 he will have his 97th birthday. Many happy returns!

With deep regret we report the death of Joseph C. Riley, Professor Emeritus, aged 96 on April 27, 1973. He enjoyed good health and mind and was very active until a quiet passing in his home at 518 Great Plain Ave., Needham, Mass. His niece, Mrs. Ann Birkett of Needham, kindly wrote about him as follows: "Born in Boston, Mass., on November 21, 1876 ('100 years after Uncle Sam' to quote Uncle Joe) and lived around Boston most of his life. He graduated from Course II, Mechanical Engineering, in 1898 with a B.S. degree. From 1899-1941 he taught Heat Engineering (internal combustion of gasoline engines) at M.I.T. He was one of the first volunteers from M.I.T. to go to Paris during World War I, a Major on

special assignment with the Air Service to test aircraft engines. He never married; travelled extensively in Europe, speak-

ing several languages fluently.

The American Society of Mechanical Engineers claimed him as a member for 64 years, and in 1959 a delegation from M.I.T. went to his home to present his 50-year pin. In 1909 he rode in the Zeppelin from Berlin to Italy while at an A.S.M.E. convention in Berlin. During his career he worked for Thomas Edison in New Jersey. He was a scholar and avid reader. Other hobbies included aerial photography: making many cameras, taking pictures with them from kites he had constructed, developing all his own pictures. He played the banjo and even made one. His basement workshop was fabulously well equipped. Uncle Joe didn't talk much of his accomplishments, which were many. He loved the ocean; enjoyed his boat in earlier years, sailing the New England coast, and he owned a house on Third Cliff, Scituate, Mass. He spent his whole life helping others-especially his invalid mother with whom he lived. He leaves one sister, seven nieces and nephews, 22 grand nieces and nephews, and three great grand nieces and nephews."-Mrs. Audrey Jones Jones, Acting Secretary, 232 Fountain St., Springfield, Mass. 01108

02

Thanks are due to Melhado, Secretary of 1927 for the following clipping from the New Rochelle Standard-Star of June 18, 1973. "Carlton B. Allen, retired President, announced at the June meeting of the Board of Trustees of the Peoples Bank of Savings of New Rochelle, that he will be moving to Cleveland, Ohio and tendered his resignation as trustee.

Allen was born in Holliston, Mass., August 3, 1880. In his teens, he served as first mate on the square rigger "The Hawaiian Isles, and sailed around the world. Through his life afterward he has been known to his friends as "Skipper". In 1902, he graduated from M.I.T. with a Bachelor of Science degree. He was engaged in real estate and insurance in New Rochelle until joining the bank in 1931 as Trustee. Allen became President of the bank in 1934 and retired from active duty January 1, 1959, continuing as trustee.

Long a resident of New Rochelle, before moving to Larchmont, Allen has been active in many civic enterprises. He was one of the organizers and is a former president of the New Rochelle Lions Club and recently received the Lions Club 50 Year Award.

Allen's resignation as an active trustee of the bank was accepted with deep regret, and he unanimously designated "Trustee Emeritus" according to the board's announcement."—Burton C. Philbrick, Secretary, Greycroft Inn, 68 Dane St., Beverly, Mass. 01915

03

An historical teature regarding the office of M.I.T. Class Secretaries has recently been called to my attention. I learn there was an "Association of Class Secretaries" for all graduates and undergraduates in 1893. Frederick H. Fay, '93, and Mr. Charles F. Reid, Assistant Secretary, assumed office. However the first listing of Secretaries by classes appear in 1906. Howard Morse was Secretary in 1903 and Walter H. Adams was Secretary, from 1904 to 1908. Of further note to our classmates, Frederick H. Olmstead, Secretary from 1908 to 1911; Myron H. Clark, 1912 to 1920: E. J. Buxton, 1921 to 1922: Chester S. Aldrich, 1923 to 1928; Frederick A. Eustis, 1929 to 1956; Leroy B. Gould, 1957 to 1960 and John J. A. Nolan, 1961 to date.

Clarence M. Hardenbergh, former President and Chairman of the Board of Commander Burabee Milling Co., and former Director of Archer Daniels Midland Co., passed away September 11, 1972. Clarence's address was 66 Groveland Terrace. He was a member of Minneapolis Minikahda and Kansas City Clubs.

He is survived by his widow, Margaret Nichols Hardenbergh; two daughters, Ester Hardenbergh, Washington, D.C., and Mrs. Charles (Mary H. Dethier) Wayne, Pa.; one son, Collis M. Wayzater; 14 grandchildren and two great grandchildren. Memorial services were held at St. Mark's Cathedral, Groveland.—John J. A. Nolan, Secretary, 13 Linden Ave., Somerville, Mass. 02143

04

The only news we have to report is as

follows: A change of address for Robert Phinney as of May 1973 to 96 Clintwood Dr., Rochester, N.Y.

Henry Kendall of Gardner, Mass., passed away on April 20, 1973.

We expect to hear from others about their summer vacations to report in the next issue.-Eugene H. Russell, Jr., 82 Stevens Rd., Needham, Mass. 02192

In July 1972, when I was summoned to an adjoining town to take a test for my driving license, I was ushered up to a camera, my picture taken for my license card, then to the eye-testing machine, where I showed sufficient reading capacity, then back to my seat where I was eagerly presented with my license card with my picture (or a "reasonable facsimile thereof"). I went to find out whether at my age I was competent to drive a car safely. I didn't. However, on June 4, 1973, when I drove in from Wilmington, Mass., to Cambridge on fourlane highway #93, surrounded by huge trucks and speeding autos, I discovered that I had had a sufficient test and, because of a half hour of intense pressure, was qualified to drive a car. To get to Alumni Day next year I will probably use the B and M train and the Boston-Cambridge subway.

All of which is to tell my classmates that I am in good health, and mind, ready to try to give them ten times a year, news of their classmates. As to our 68th Reunion, we had two members at the "head table," Henry Buff and myself. Ruth accompanied me, and Mrs. (?) Henry Buffor Mrs. McDonald-who has been Henry's faithful chauffeur since he took residence on the Cape (Cod). Also at our table were Arthur Collier and his wife, '02, John J. A. Nolan, Secretary of 1903, and Mr. and Mrs. Ichabod Atwood, also 1903. We missed Gene Russell, '04, who usually joins us at the head table. As previously suggested Len and Beatrice Cronkhite reunioned with Len's 1905 class at Brown. He says, "No one else in my class was near enough or well enough to attend, so my hat band with 1905 on it caused

a minor sensation."

I have just received from Colonel Robert S. Beard a 238-page portfolio entitled "Patterns in Space." It is very difficult for me to describe its magnificence. It is described in the Preface as a minor modification of the collection of drawings originally made available through the Fabonacci Association in 1971. Each of the 238 pages is filled with intricate and beautiful designs, the work of a genius in geometrical expression. A professor at California State University at Hayward has written these words about the author. "Since his graduation from M.I.T. in 1905, he has been a successful railroad engineer, city engineer, career army engineer, and creator of beautiful geometrical designs. At the age of 90 his hand is steady, his eyes keen, and his sense of humor acute. For nearly three decades he has shared his collections of polyhedra with the mathematical community." Bob, during the years, has sent me examples of his polyhedra models.

which I have exhibited as conversation pieces, marvelous exhibits of his wondrous accuracy, skill and patience.

Chester Shaw, Course VI says, "So you crave statistics? I am one of those who did not follow engineering after the first year. Many years ago I became a C.P.A. and was chiefly employed as a teaching auditor by two corporations, covering all of mainland U.S.A. and some Canadian provinces." . . . Lloyd Buell Course III in response to my question as to how many of us followed graduation with an engineering career writes, "Willard Simpson went into real estate for awhile. As for myself, I still enter myself as an Engineering Accountant on the income tax form although I have not been an engineer for 50 years. After seven years, first with Tennessee Copper Co., and then Miami Copper Co .- the same peoplein 1912 they asked me to design and supervise the metallurgical and cost records on the start up of the concentrator, which I did. In 1918, after two years of mine examination for South American Metal Co., in Chile, they placed me in charge of the accounting office in Santiago when the German staff was kicked out. In 1922, after two years in Douglas in the Engineering Department of Phelps Dodge Corp., came a recession and curtailment and I was moved to the (internal) Auditing Department. Three years of that and I took over the accounting office of their Copper Queen Branch, in Bisbee, where I stayed for 25 years until retired. A year later I took over the office on a job in El Paso for a joint venture of three General Contracting firms. This connection came about through the Phelps Dodge auditing firm which was in touch with one of the General Contractors. Long ago I worked for a short time for Harrington Emerson as an "Efficiency Engineer," where a little common sense got much favorable notice. And for a while I worked for the Review of Reviews in New York City."

In the "I ain't as young as I used to be" file I find these comments. From Roy Allen, "Have been invited to take residence in our infirmary (Orangewood Apartments) but as long as I can take care of my apartment and myself, I shall not willingly move." . . . From Bill Ball, "I wake up weak and no pep. Have been taking pep pills to boost my circulation and two other things for some other things." Strange for Bill who just a few years ago was head of the Power Squadron in Boston. . . . From Sam Seaver, "With all my ailments I seem to be in darn good condition. However, my doctor has discovered I have a hiatus hernia."

Nice going, Sam.

A letter from Doc Lewis explains that his title was acquired 75 years ago, because he carried notebooks, texts, problems in a bag of a type which was widely used by physicans in general practice. Seems as though "Doc" was further justified by his many doctorates received since graduation. I recently received a notice of another honor bestowed upon Doc by some university or engineering association, but since it is not immediately at hand and since it would be a case of "ditto," I'll just say another honor to a great guy. Doc adds, "I am

here (Duxbury, Mass.) with my daughter and her family, fortunate beyond words to be in such care." Isn't it great to be pampered by loving daughters, Doc?

A recent issue of the Boston Herald American tells of the appointment by President Nixon of Dr. Leonard W. Cronkhite, Jr., to serve on the Health Advisory Committee of the Cost of Living Council. Dr. Cronkhite is now President of the Children's Hospital Medical Center in Boston. Further congratulation to Leonard, Senior.-Fred W. Goldthwait, Secretary, Box 231, Center Sandwich, N.H.

The only mail recently received has been to report the death of classmates, and I spotted another death in the paper. In July I received a letter from Mrs. John Norton from Tryon, N.C., enclosing a clipping about Jack. John Foote Norton was born June 23, 1883, in Natick, Mass., and died June 27 in Columbus, N.C. While at M.I.T. with '06 his home address was Chicago where he had attended the South Side Academy. While at M.I.T. he was a member of K2S, Sigma Xi, the Chicago Club and Chemical Society. His thesis was on-The Synthesis of Tetramethylene. After getting his degree he continued on as an instructor in Sanitary Chemistry (whatever that was) until around 1916 when he was at the University of Chicago in the department of bacteriology, continuing there until the fall of 1928 when he was in the Board of Health Labs in the Herman Keifer Hospital in Detroit, continuing there until around 1933 when he joined the Upjohn Co., in Kalamazoo. Around 1950 he earned a Ph.D. at the University of Chicago and he and Mrs. Norton soon retired to live in Tryon, N.C., where they had bought the famous Lindsay Vineyard. They both played bridge and Dr. Norton was a member of the Men's Duplicate Bridge Club until a few months ago, and he was the last of a Happy Foursome of distinguished golfers who averaged 85 years of age. "Dr. Norton's cheerfulness and good sportsmanship were an inspiration to many". Jack married Margaret Goodrich of Auburndale and they had two sons. Margaret and my wife were close friends during school days.

Another death to report is that of John Timothy Wrinkle S.M.'07 in architecture, on April 7 in a nursing home in Springfield, Mass. He was born August 5, 1883, in Plattsburgh Mo., and his home address while at M.I.T. was Holyoke, Mass., having attended high school there. He was a member of the art staff of the '06 Technique and his thesis was-A Terminal Station for the City of Boston. John practised architecture all his life, both on his own and with H. L. Sprague in Springfield, and in N.Y.C. before becoming the architect for the Springfield Department of Streets and Engineering. He designed the Park Department buildings and the Classical high school, retiring in 1953 to the old family homestead in Mill River, Mass. In 1921 he married a cousin, Mary Wrinkle, in Holyoke, and in 1971 they were honored on their 50th anniversary at a buffet lunch at the home of a son in East Longmeadow—they had two sons and two daughters, 23 grand-children. They spent recent winters at Daytona Beach and I have a photo of them taken there. John and I had corresponded and he was a donor to the Alumni Fund. A note of sympathy was sent to the widow on behalf of the class.

William Adams Sheldon was born July 8, 1882, in Ashby, Mass., and died July 1, 1972, in West Barnstable, Mass. While at M.I.T. his address was Ashby; he prepared at Cushing Academy; was a member of the mining engineering society. After getting his degree with '06 he was employed for a few years in a mine in Mexico, then for many years in mines in Colorado, retiring in the late 50's I believe.

I spotted an item in a Boston paper reporting the death of one of our coeds. Eleanor Manning-Mrs. Johnson O'Connor-who was born July 27, 1884, in Lynn, Mass., and died July 12 in Mexico City. She had prepared at Lynn Classical High and while at M.I.T. was a member of that group of gals called Cleofan. Her thesis was-Design for a country residence. A native of Lynn, she maintained homes in N.Y.C. and on Beacon St., in Boston. She was the first woman graduate of the M.I.T. school of architecture. in 1906; joined the architectural firm of Howe, Manning and Almy soon after graduating; later she specialized in the restoration of old homes. She was the widow of Johnson O'Connor, a pioneer in aptitude testing and founder of Human Engineering Laboratories in Boston. He had died just a few days before, in Mexico City. I had become acquainted with Eleanor Manning in Lynn during high school days. She was a charming lady and is survived by four sisters. A note of sympathy has been sent to one of the sisters on behalf of the Class.

Just recently I received a note from Donald L. Pope, SM'56, from Portland, Ore., with attached copy of newspaper clipping about the death on June 30, of Robert Ellis Cushman. I had also heard from Henry Mears in July enclosing a clipping about Bob, and from Fay Libby too. Those three '06 men living in Portland had been keeping in touch through the years, at meetings and by phone. Henry had this to say about Bob, "He was able to drive his car and when I talked with him he seemed full of pep. Fay and I are both failing but we can sit up and take nourishment, and talk coherently." Robert Cushman was born March 10, 1884, in Kingston, Mass., and prepared at the high school there; got his M.E. degree with us; he died June 30 in a Portland hospital after several weeks there during which he was visited by a 1925 man, George G. West who wrote to me in July and also enclosed a clipping. He had attended M.I.T. alumni and A.S.C.E. meetings with Bob for many years and had often visited him at his home. His letter ended, "He was an outstanding gentleman. Some of the positions he held were with American Bridge Co., of Edgemoor, Del.; Purdy and Henderson, and D. C. and W. M. Jackson of Boston; Whitehouse and Fouilhoux of Portland: Pacific Tel. & Tel. Co.; Assistant to City Engineer of Astoria, Ore.: Federal Lighthouse Service; U.S. Bureau of Public Roads and with Pope and Talbot for 15 years until his retirement around October 1949. Bob had been active in civic and fraternal affairs-was past president of M.I.T. Club of Oregon and of the National Societies of Professional Engineers and life member of the Oregon Section of A.S.C.E. He was a longtime member of Oddfellows Eden Lodge 34 of Wilmington, Del., and an associate member of the Peninsular Lodge in Portland, also a member of the Unitarian Church in Portland. He is survived by a son, Kenneth, and several grandchildren and greatgrandchildren. A note of condolence has been sent to the son. Guess that's all for now. Edward B. Rowe, Secretary-Treasurer, 11 Cushing Rd., Wellesley Hills, Mass. 02181

08

For our 65th Home-Coming Reunion we only received replies from five registration forms: Harold S. Osborn; Franklin T. Towle; Raymond F. Drake; Leo M. Loeb, Jr., and Joseph W. Wattles, 3rd.

Leo Loeb, unfortunately, had a death in the family and had to rush back to New York. Out of the 350 graduates of '08, there are actually 78 survivors, a goodly number, scattered in all parts of the world. Many in advanced years and not able to come. I am including this in the Notes because there were so few at the Reunion.

We have lived through the fastest development period in centuries; from the "Horse and buggy days" to "Putting men on the moon."

Thomas Edison, Henry Ford or Alexander Bell did not go to M.I.T. but our engineers took over where they left off.

One of the greatest engineers and promoters of this period is Colonel William F. Rockwell. He has perfected the millions of automobiles and trucks on our highways by merging the builders of the best axels, gears and other accessories, to be assembled in each automobile or heavy truck. He then advanced to airplane construction, with his son, organizing a new concern under the name of Rockwell International,

Another well-known electrical engineer of '08 is **Harold S. Osborn** elected President of the U.S. National Committee at the Hague in 1949. Their first meeting was in Yugoslavia with others following at Moscow, New Delhi, and Tokyo.

Another civil engineer of our class is George Schobinger of Swathmore, Penn. He has handled big construction work in all parts of the world. He supervised the bracing of buildings for soft ground construction of the Chicago subway and took charge of the design and construction of the Colorado Syphon 90 feet under the Colorado River at Yuma, Ariz. . Another engineer from our Class was Herbert A. Cole, Jr., who has spent most of his life with the New England Telephone Co., using the same shop in Hingham that Alexander Bell used. His recent work has been to perfect the individual dialing system between all telephone subscribers in the U.S.

Another member of our Class was Henry W. Spurr, a civil engineer of Edgartown, who specialized in wind bracing of tall buildings.

He took charge of constructing several tall buildings in New York, one 71 stories, considered the tallest in the world for some time. He wrote a book Wind Bracing of Skyscrapers.

And finally we recall the development of synthetic fibers by our Carl Bangs, '08; Plant Engineer for the Celanese Corp., of America at Rome, Ga.

The completion of the great railroads across the country was layed out by civil engineers, and the steam driven locomotives that pulled our freight and passenger trains were designed by mechanical engineers of earlier classes. The advancement in photography by Eastman of Rochester, N.Y. was accomplished by an earlier graduate of M.I.T. The introduction of sprinkler systems to protect mills against fire was supervised by our

We should not overlook the development and management of the great Suger Refineries by our graduates: A. B. Babcock of Darien, Conn., Chesney H. Criswell of Estes Park, Colo., and William H. Toppan of Amesbury, Mass.

former Secretary "Nick" Carter.

We are sorry to report the death of three of our classmates; George A. Abbott, of Grand Forks, N.D., died April 16, 1973. . . . Edmund L. Warren, of Kensington, Conn., died November 17, 1971. . . . John Gianella, of Brightwater, Long Island, N.Y., died March 15, 1973. Finally we report the death of Mr. Rufus C. Folsom of 26 Burditt Ave. Hingham, Mass. 02043. He died July 19, 1973. He retired as Manager of the American Sugar Refining Co. of Boston where he worked 45 years. He graduated from Harvard in 1907 and received his master's degree in 1908 from M.I.T.

There are five changes of address to report: John S. Barnes, 207 Old Lancaster Rd., Devon, Pa. 19333. . . . William H. Medlicott, 2005 S. Vine St., Urbana, III. 61801. . . . Mrs. Charlton D. Putnam, 1804-D Woodbrear Dr., Dayton, Ohio 45440. . . . Frederick N. Peirce, 4 Berkeley Ct., 3 Wellesley, Mass. 02181, and Mrs. Edmund L. Warren, 69 South St., Fairfield, Conn. 06430.—Joseph W. Wattles, Secretary, 26 Bullard Rd., Weston 02193

09

There were seven of us attending Alumni Day, Monday, June 5: Margaret Davis, Chet Dawes, Mayo Hersey, Ben and Barbara Pepper, Art and Betty Shaw. The morning began with a most interesting lecture by Professor Emeritus Harold Edgerton, '27, who has attained world renown for his instantaneous photos of such phenomena as a drop hitting a surface, a humming bird extracting nectar from a flower, and for his underwater photographs of ancient ships such as Roman galleons lying on the bottom. This lecture was followed by a meeting including refreshments with the Technology Review staff among whom were Editor John Mattill, Margaret Kelly, who edits these Class Notes, and her sister Mary. Luncheon was enjoyed in

the large Rockwell Cage. As usual, fourteen banners bearing reunion class numerals were suspended on tall standards placed across the very wide stage, seven each side of center. This year the first on the left was '08, then every fifth year ending with '73. Next year the sequence will begin with '09, the 65th anniversary of our granduation! We have become one of the oldest classes.

At the luncheon we were most pleased to have the company of Karl L. Wildes, Professor Emeritus of Electrical Engineering, who is now writing the history of the Institute and is joint author of a widely used textbook on electric circuits and transients, and well known by your Secre-

Barbara and Ben Pepper plan to be at their summer home at Crow Point, Hingham. . . . Margaret Davis has been on a tour of the Scandinavian countries. . . . More than once we have told of Mayo Hersey being a Visiting Professor at Brown University conducting research on his specialty, lubrication, on which he is a recognized authority. We have recently received a copy of the Providence Engineering Society publication, Engineering, containing a biography of Mayo's career, his photograph, and the many honors which have come to him. Because of present space limitations further notes on his career will appear in later notes.

We have already stated that Florence Luscomb is a Class Secretary's delight because of her continual activities and press notices about her which come to the Secretary. Along with the Alumni Day literature was a page devoted to a "Century of Women Students at M.I.T.", commemorating a century of higher education for women at M.I.T. The notice contained a photograph of Florence along with others including former President Julius A. Stratton. Florence's contribution was a report on the life of Ellen Swallow Richards, the first coed to gain admission to the Institute. After graduation from Vassar Mrs. Richards wanted to study chemistry but was turned down by col-lege after college because she was a woman. Finally, she applied to M.I.T. and was admitted in 1870. So far as is known, she is the first woman to obtain a bachelor's degree in science. She became an instructor at M.I.T. and attained world fame in chemistry, water supplies, health education and nutrition, and was the author of books and several scientific articles. In 1875 she married a fellow student in mining, Robert Hallowell Richards, who became head of the mining engineering department and was still on the faculty while we were students. We have received a bound pamphlet about the testimonial dinner, on Thursday, June 14, 1973, at Simmons College in Boston in honor of Florence H. Luscomb and her "lifetime dedicated to peace and freedom." The testimonial was sponsored by 32 eminent people and there was a panel of nine speakers including Florence. A furhter description of the events of Alumni Day and "Women's Places in America" including Florence Luscomb's participation are given on pages 109-116 in the July-August Review.

We were pleased to receive through the Alumni Office from Phil Chase, Course VI, the following which refers to the summer of 1972, "Theora and I had a pleasant summer and fall as usual at our place in Kennebunk Beach, Maine. We had a two-day trip last November to Washington with a wonderful tour of the White House and a hectic ten-day trip to Florida at Christmas time. A piece of advice: don't try driving a car in the Miami Airport without a guide." These Notes were written at your Secretary's summer cottage on the Isle of Springs, Maine, not too far from Kennebec Beach.

It is with regret that we report the death of the following classmates: Edward T. Williams, of Berkeley, Calif., on April 1, 1971; Christian Kurtzmann of Buffalo, N.Y., on December 2, 1972. Both notices were received at the Almuni Office from their widows.-Chester L. Dawes, Secretary, Pierce Hall, Harvard University,

Cambridge, Mass. 02138

Excerpts from eulogy to Ralph Walker by E. James Gambaro. F.A.I.A.: "Ralph Thomas Walker was The first Chancellor of the College of Fellows. He was the 32nd President of the American Institute of Architects and it was he who, at the end of his second term, brought the College into being. This College, in truth, is the child of his vision, conceived by him as an instrument to bind constructively and more closely, those who have been found by their peers to be deserving of Fellowship.

"In its concept, the College of Fellows was completely in character, for Ralph Walker was an idealist and a realist, a pragmatist and a poet, a man of ego and conscience, who lived his life in constant fulfillment of his own idealsas an architect, a philosopher, humanitarian and as an individual. Ralph was the Renaissance man, in love with the manifestations of nature and impatient with

mediocrity.

"Friends have said that his passing 'marks the end of an era.' Without doubt times are changed. But even in the times which have followed-times he once declared would be known one day as 'The Age of Brutalism'-even today, there is little need to recall to architects, Ralph Walker's own achievements as an architect. We might recall that he was the recipient of the Belgian Order of the Crown, the French Legion of Honor and many other citations and that of all the honors, the one he prized most was the Centennial Medal of the Institute, conferred upon him in 1957 at our 100th Anniversary

"For Ralph Walker was a man of optimism and of hope, a man whose eulogy might well be his own words, ones that he spoke upon his acceptance of the Gold Medal of the New York Chapter, at the Town Hall in New York, on February 21, 1950. Those words, which each of us would gladly utter, were these: "I have stood also at places I have helped to build, and always there is within my heart the desire that some other architectas so often I have felt in other places, and for a brief moment-here may feel both the calmness and fierceness of creation, and go away saying, 'Here too someone has served beauty."

The most recent address of Allston T. Cushing is: 517 B Peace Parkway, John Knox Village, Lee's Summit, Mo. 64063. In the letter giving me the new address he said he was graduated from the University of New Brunswick. There were 19 in his class there and only two are still living. He wondered how many Eleveners are still alive. There are 44 left who graduated with us and about as many more who are affiliated with the class but did not graduate.

Hubert Judd, P. O. Box 664, Dalton, Ga., 30720 died this past April. His son, H. Morton Judd asked that the following be published: "My father passed away on April 20, 1973, at the age of 86. He is survived by his wife, Kathryn J. Judd, myself, his son, and a daughter, Mrs. Jane J. Deck. There is a bequest to the Alumni Fund for \$500 which you should receive in the near future." ... One more death I have to report: Frederick L. Woodlock, 18 Cranberry Lane, Harwich, 02645, died May 1. The only two times Frederick has been mentioned in the Class Notes were February, 1971 when he moved to Ridgefield, Conn., and March 1972 when he moved to Indianapolis.

Minot S. Dennett is now at 339 W. Barry #16C, Chicago, III. 60657. . . . Harry Tisdale spends much of his time mowing neighbor's lawns. A letter in May said it was very dry in Ft. Meyers Beach, but a later letter in August said the rains had come and the grass was growing fast. I cut only my own lawn (16,000 square feet). This has been the wettest season around here in many years so my grass is growing like mad .- Oberlin S. Clark, 50 Leonard Rd., North Weymouth, Ma.,

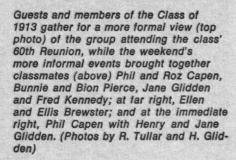
02191

This year there were but six present to celebrate our sixty-first Reunion luncheon on June 4. They were Fred Busby, Ray Wilson, Phil Dalrymple and Helena, and Cy Springall and Marjorie. Jerry Hungsaker was prevented from attending by a broken hip bone although he is recovering normally. . . . Al Davis is recuperating satisfactorily from a slight heart attack, his second. We talked with both by phone and also with Fritz Shepard, who was just leaving for a summer at Marblehead, Mass., as usual, though his arthritis is little better. The Alumni Day program was similar to that of last year, including an all-Tech Pops Concert at Symphony Hall. Fortunately, I was invited to be the guest of the Class of 1913 at their 60th Reunion dinner and gave them a brief talk on my hobby, Covered Bridges. They had an attendance of 18 men and 14 wives which was the same total we had last year.

Bill Collins writes from Hornell, N.Y., that he and Pauline are well and that he is keeping very busy in his work as a highway contractor, thus conforming with the advice of his physician to do so. . . . John Noyes phoned in June that he was feeling fine and planned to spend the summer at his cottage in Brooklin, Maine, as usual. . . . John Selfridge writes to









Akron and also travelled much abroad. Our sympathy and that of the Class was sent to his wife, Margaret from whom I received the notice of George's passing.

Ken Barnard writes from Barnstable, Mass., that he is again retiring as consultant in chemistry for the Colonial Candle Co., on account of age. On June 30 he and his wife celebrated their sixtieth wedding anniversary in the same church in which they were married. He says their health is reasonably good. Congratulations. H. C. Dunbar and wife say they are enjoying Damascus, Va., where they recently moved from Miami, which they had found too crowded and expensive.

I hope to be in South West Harbor, Maine in August with my daughter and some of her family. This will be my thirty-second summer visit to that delightful village.-Ray E. Wilson, Secretary, 304 Park Ave., Swarthmore, Pa. 19081



The 60th Reunion of the 1913 Class. M.I.T. was highly successful. It was held on campus June 1 to June 5, 1973. The planned events were the informal reception on Friday, tour of New Boston, luncheon at the Aquarium Restaurant, the class picture social hour, class dinner and class meeting on Saturday, and luncheon on Sunday followed by the Alumni Day. The program was enjoyed by all. Of course, the highlight of the Reunion was the Class Dinner and meeting. Charlotte Sage presided and Bill Brewster for the Class presented the Capens with a plaque and a sizeable purse in appreciation of their efforts over the years. These awards were suggested by our late president, William R. Mattson. The following officers were elected: President, Henry O. Glidden, Vice Presi-

advise of the sudden passing of his wife last January which occurred just after celebrating their fifty-ninth wedding anniversary. They had recently moved into a large new retirement apartment in Greenbrae, Calif., and were most enthusiastic about the facilities. Fortunately, John has a daughter and daughter-inlaw who live nearby. Our deep sympathy to you, John. I well know what such a loss means. . . .

We have word from George Robinson, Course I, of Silver Springs, Md., who writes briefly that his health is still "fair to middlin'.

I regret to report the sudden death of George M. Sprowls, Course VI which occurred in Akron, Oh. on June 25, due to a stroke followed shortly by a coronary attack. His health had been excellent and he played golf weekly up to the time of his illness. George spent his career with the Goodyear Tire and Rubber Co., in

dent, Charlotte Sage, Secretary and Treasurer, George Philip Capen, Assistant Secretary, Rosalind R. Capen, Alumni Fund Agent, Ellis W. Brewster, Representative to the Alumni Advisory Council, Francis Achard. Ellen and Bill left early June 3. Bill was operated on Sunday at midnight and had a kink in his intestine straightened out and his appendix removed. He is recovering very satisfactorily. We have received several notes from Ellen and Bill and exchanged a few telephone calls. We received a number of letters prior to the Reunion stating that due to previous commitments, ill health, surgery, and the great distance from Cambridge that they would be unable to attend: J. W. B. Ladd, Leon W. Parsons, Stanley W. Parker, Paul V. Cogan, Harold E. Crawford, Raymond B. Haynes, Edward W. Bridges, David V. Nason, Warren A. Gentner. Also, Arthur B. Hirst whom we talked to by phone soon after the Reunion. Charlotte Sage reports that Marion Rice Hart wrote to her from Ceylon while waiting for radio repairs on her plane.

Again it is our sad duty to report the deaths of several of our friends and classmates. Seaphes D. Shinkles passed away July 12, 1971. We have written a card of sympathy to Mrs. Shinkles, but the card was returned marked "Movednot forwardable." . . . Victor Mayper died June 22, 1972 (no details). . . . George E. Hodge, former New England Manager for the Armstrong Cork Co., passed away February 22, 1973. An East Boston native, he was a graduate of Boston Latin School. He served as a naval officer during World War I. For a number of years he was sales manager for the Armstrong Cork Co., in Lancaster, Pa., and later succeeded his father, Jacob F. Hodge, as New England manager of the firm. He was a director of the East Boston Savings Bank for several years and later named vice president and a member of the bank's board of investments. He was past master of the Baalbec Masonic Lodge, East Boston. He is survived by his wife, Georgie M. (Webster); a son, George E. Hodge, Jr., of Wellesley and a sister, Mary L. Hodge of Winches-

We received late word from Mrs. Sarah Font of Manuel Font's death in Puerto Rico on June 11, 1973. . . . John H. Hession deceased April 24, 1973; Edward Hurst passed away May 3, 1973. Ed was always a loyal 1913er. He was born and educated in New Zealand. Before entering M.I.T. he was a licensed machinist. A note was received from his daughter, Mrs. Barbara Hurst Root and we quote: "Thank you for your note regarding a notice of Dad's death in the Technolgy Review. Basically, the only information the family feels should be included is a mention of his 50 years association with Dart Industries-Rexall, and his many, many abrasive patents. The last years of his life were devoted to his garden and workshop. Here he made plans for helping people less fortunate than he. Dad died on May 3 in Worcester. He sold his Duxbury house a year ago and lived close to me in Shrewsbury. His wonderful mind and great sense of humor never varied 'til the end." Ed and his wife were very much interested in the Perkins Institute for the Blind. He invented and produced in his well-equipped machine shop in his Duxbury, Mass., home many helpful appliances for the blind. He was also interested in organizing a group of retired engineers and scientists to cooperate with medical researchers which was not concluded due to his failing health.

The death of our Class President, William R. Mattson, May 17, 1973 was a great shock to us. We quote: "William R. Mattson, who lived at 13095 W. 15th Drive in Golden, Colo. passed away May 17, 1973. He was born January 17, 1891, in Philadelphia and was graduated from M.I.T. in 1913. He was the founder and a member of the Gamma Phi chapter of Kappa Sigma Fraternity. Mattson was married to Josephine Davis on September 13, 1958, and moved to Colorado in 1959. He was employed for a time as President and Director of admissions for Babson Institute. He retired in 1957 after serving for 26 years as Vice President in charge of advertising for the American Locker Co., of Boston. Mattson served as Chairman of the Jefferson County Chapter of the Red Cross for two years, and was a member of the M.I.T. Alumni Association, Dalhousie Masonic Lodge of Newtonville, Mass., the Aviation Club and Mt. Vernon Country Club. Memorial gifts may be made to the M.I.T. Scholarship Fund, in care of Fred Lehmann, Cambridge, Mass., or Jefferson County Chapter, American Red Cross, 1425 Brentwood Ave., Lakewood." Bill was always active in his four years at M.I.T., and as you may remember was Senior Class President, After graduation he was Reunion Chairman for many years, as well as Vice President of the Class. He assumed the Presidency in December 1971 when R. Charles Thompson died. We shall miss him and his ever cheerful and frequent letters. We have sent sympathy cards to all of the families of our deceased classmates, including Mrs. Janet Pillman, Bill Mattson's daughter. A memorial service was held in the M.I.T. Chapel, Monday June 4, 1973 for all members of the M.I.T. Alumni who have been reported deceased from May 1972 to May 1973.

The success of our 60th Reunion was due for the most part to the cooperation of Richard Knight, Secretary of the Alumni Association and his staff, and John Mattill and his staff. Also, we thank President Albion R. Davis, Ray E. Wilson of the Class of 1912; also President Parke Appel and members of the Class of 1922 and Walter M. Saunders for their advice and suggestions. Well, gals and boys keep your letters coming. Remember our next Reunion in 1978, the 65th .-George Philip Capen, Secretary and Treasurer, Rosalind R. Capen, Assistant Secretary, Granite Point Rd., Biddeford, Maine 04005

Ray Dinsmore, Eleanor and Frank Atwood, and Lois and I represented the Class at Alumni Days last June. Our importance as such representatives was recognized by a motorcycle cop who, with siren and flashing lights, led our bus from the Institute to Symphony Hall, for Tech Night at the Pops.

Our 60th Reunion in 1974 will include Alumni Days, presumably Sunday, June 2, and Monday, June 3, and probably a day or two just before. Now is the time to fix up your schedule for next spring so you can be on hand, and to send your suggestions for the party to R. P. Dinsmore, 795 Merriman Rd., Akron, Oh. 44303; L. F. Hamilton, M.I.T. Room 2-321B, Cambridge, Mass. 02139; or to me. You'll get more information as the plans

are worked out.

In July, the Alumni Association sent me a note which Earle Turner had written in the spring. I received a later newspaper clipping, telling that, in spite of a malignant right arm, and years of surgery and cobalt treatment, Earle had played in the New England Seniors Golf Tournament in June. Because an impending amputation of the arm was mentioned, I telephoned him one evening. He said that the surgery had stopped the cancer, and that he saw no reason why he should now "crawl under the bed". Earle promptly sent me copies of two of Jack McCarthy's columns in the Boston Sunday Herald Advertiser. The second one, dated July 15, referred to the previous account of Earle's participation in the tournament and went on, "At the time, Dr. Turner had said he planned to play again, 'although it might be a little difficult for me because I'm left handed'. Well, by glory, they did take the doctor's arm, three weeks ago Wednesday, and this past Tuesday, danged if he wasn't out playing again. Said Dr. Turner, "The operation took a little bit out of me, and when I played nine holes Wednesday I was a little dis-couraged. But I played eleven holes Thursday, and I think I'll make out all right playing with my left arm." In his letter with the clippings, Earle mentioned that he was undergoing therapy preparatory to fitting for a prosthetic arm.

In 1955 Earle was president of the Royal Canadian Golf Association, and he sent me a copy of a cordial letter which Arnold Palmer had written him in May, beginning, "It has certainly been a long time since that happy moment when you handed me the winner's check for the 1955 Canadian Open, my first pro win." Referring to Earle's determination to continue playing, Arnold said "I think this is just great and I'm sure that everything is going to be successful—the surgery and your return to play." We can all share in this sentiment, and in the inspiration of Earle's courage and cheerfulness.

William L. McPherrin died on July 12, 1973, after an illness of several months. He was a native of Kansas City, Mo., where he lived most of his life, and received his bachelor's degree with us in Course II. In recent years he had divided his time between that city and the San

Francisco area, and last spring he completed 50 years of association with the Kansas City Life Insurance Co. With his wife, the former Beatrice Klein, he attended our 50th and 55th reunions. In a letter telling me of Bill's death, James C. Irwin, '18, a long-time friend, wrote that Bill and Beatrice had traveled extensively in North America and around the world, and had made an outstanding photographic record of their travels. "Bill had many interests, a principal one being the history of the Kansas City area and the development of the Great Plains and the West by our pioneers. He had served as President of the Native Sons of Kansas City and was involved in the restoration of historic sites." Bill is survived also by two sons, James W., of Victoria, B.C., and John W., of Redwood City, Calif. (where Beatrice is now living), and six grandchildren.

New addresses: Lyman S. Baird, Rancho Bernardo, 16627 Roca Dr., San Diego, Ca. 92128; Raymond D. MacCart, Highland House West, Apt. 801, 4450 S. Park Ave., Chevy Chase, Md. 20015; Walter H. Monahan, c/o Miss Sara Monahan, 3 Governor's Rd., East Milton, Ma. 02186.—Charles H. Chatfield, Secretary, 177 Steele Rd., West Hartford, Ct. 06119

Hello everybody! Here beginneth the first column of the new season, with the hope that you and your families have enjoyed a pleasant and happy summer. I hope you all will appreciate what the old Pirate does to keep ours "The Class Supreme"-always willing and ready to cooperate and help. George did a lot to set up our very successful annual class cocktail party and dinner at The M.I.T. Faculty Club on Alumni Day, June 4. Strapping on his skull and cross-bones helmet, sharpening up his cutlass and oiling his brace of boarding pistols, he took charge and kept his crew of Barbara and myself on the alert to make it one of our best and most successful class parties.-Splendid, stupendous, supreme. That is what it was-31 for cocktails and 21 for dinner following—a good show. The "younger members" of the Class with their families added a lot and were particularly welcome. We want them to join us every year.

Barbara Thomas, really a part of the Class, with her friendly and personable presence added a great deal to the party and was a gracious hostess. It was great to have Mary Plummer Rice with us again, also Mae Sheils and Mary Scully. Long distance plaudits to Larry Bailey and son Bob, '41; Bee and Charlie Norton, Martha's Vineyard; Larry Quirk, Middletown, Conn.; Pop Wood, Peterboro, N.H. Ben Neal phoned from Lockport, N.Y. Attending the festivities over at M.I.T. on Alumni Day were Larry Bailey, Jack Daiton, Archie Morrison, Pirate Rooney, Fred Waters and his wife and Pop Wood

In May the establishment of the first three University Professorships was announced by Drexel University, Philadelphia. One professorship has been created within the College of Engineering. It is the J. Harland Billings Professorship in Mechanical Engineering. Billings took graduate work in Course II in our Class. With a generous contribution to the Alumni Fund, Ken Boynton wrote Ben Neal; "With the student unrest, and the changing ideas, and conditions, M.I.T. certainly has had its share of trouble and difficulty, but by and large in the adjustments that will take place, I think you will find as good a group of brains at M.I.T. as anywhere else, to try to solve the problems, and, hence, I feel that it deserves our support!"

As evidence that to get a big job done, give it to a busy man is Jerry Coldwell's work as Chairman of the Building Committee of The Roosevelt Hospital, New York. After dedicating The Arthur J. Antenucci Medical Research Building on May 9, 1973, Jerry is planning Staff Residence Building (\$17,000,000); Alcoholic Rehabilitation (\$14,000,000) and an Ambulatory Care Building (\$33,000,000)-all for completion before 1975. You wonder what Jerry does with his spare time? . . . Celebrating his eightieth birthday George Easter wrote to Ben, "Growing old is not too bad, if you have the right company." On a Scandinavian cruise in July, Ellis Ellicott wrote that Mrs. Ellicott and he were in some fine weather along the Norwegian coast. It's always pleasant to hear from you fellows who are tripping and travelling.

Writing from Clearwater, Fla., Bob Mitchell invited Ben Neal to visit him down there to show him around. Bob spends his summer visiting his widely scattered married children. . . . Herm Morse is on the Advisory Committee to the Business Administration College at Kent University, Kent, Ohio. Of his big family he is most proud of his first great grand daughter a 2 and one-half year-old girl. Any competitors for Herm?

Does any one remember (Miss) E. Charlotte Rogers, Course V? She wrote to Ben from Norwich, Conn., that she is a retired science teacher. We have no class record of her. . . . From 213 Cedarcroft Rd., Baltimore, Md. 21212, Bill Spencer writes: "Dear Classmates 1915, the last class to graduate from Boston, I am inspired to send this note of greetings to let you all know I am thinking of you and want you all to realize that if I can not join you my heart is there.

"I am retired and living alone except when some of my three splendid children or grandchildren come to Baltimore for a short visit. I would also welcome a visit or a note from any of my classmates or friends of M.I.T. For the last three years, my wife, Ethel has been seriously ill and has been living with my son in Richmond, Va." He is an M.D. and a Professor of Medicine at the University of Virginia in Charlottesville. Here's that Jim Tobey pulling my leg again about tripping around on our Class funds-Ah, me! But, he's really a good guy! "I trust that all is well with you and Fran although this may find you in Yugoslavia or Iceland on one of those well-known class tours. "After a bit of a hiatus as a writer I burst forth with the feature article in the Antiques and Arts Section of the Newtown (Connecticut) Bee. It is a story about the historic old Square House, where Washington slept not once but twice, as did John Adams and Lafayette. Come down some time and I will put you up there in the same bed, after dining you at the yacht club. When you return from Patagonia, visiting classmates, drop a line."

How our men do get around! What a fascinating trip Max Woythaler must have had in March with his son, Bill, and Bill's wife and son. Writing from Vaduz Liechsteinstein, Max said: "We bought an Audi car in Germany and after a week around Austria, we came through this little country. One day the road went through a corner of Italy and we had lunch there. This auto trip has been thrilling. From here we'll have a week in Switzerland and then Holland. Driving over these Alpine passes is an accomplishment for Bill!"

William Tallman died in Fairhaven, Mass., January 19, 1973.

"Help! help!" for next month's column.— Azel W. Mack, Secretary, 100 Memorial Dr., Apt. 2-6A, Cambridge, Mass. 02142

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In the absence of our much honored Secretary, Harold Dodge, on doctor's orders, the report of our 57th Reunion at the delightful Chatham Bars Inn, Chatham, Cape Cod, was entrusted to your humble Assistant Secretary. The list of this year's total of 34 '16ers and wives reads like this: Mary and Joe Barker, Walt Binger, Hildegarde and Jap Carr, Hope and Theron Curtis, Frances and Paul Duff, Jim Evans, Sibyl and Ralph Fletcher, Mertie and Allen Giles, Barney Gordon, Gretchen and John Gore, Lois and Charlie Lawrance, Herb Mendelson, Dorothy and Dave Patten, Rose and Bob O'Brien, Izzy Richmond, Frances and Henry Shepard, Gladys and Francis Stern, Nell and Don Webster, and Nat Warshaw.

First, as a devotee of delegation, let us report contributions from several most cooperative note-takers, particularly Bob O'Brien, our honorary member. His devotion to the Class rates high and we are indebted to him for many phases of the organization and management of our reunions, though not to detract from the contributions of Sibyl and Ralph Fletcher, Who, as "First Lady" and President have kept us going for these many years. So, without further ado, here are items from Bob, as adapted by ye scribe. The "bull session" and Class meeting combined illustrated the many faceted gem which is the Class of 1916. Numerous disparate opinions were expressed in perfect avoidance of any unanimity. It was agreed that we continue at Chatham Bars Inn for another year. There is a feeling of some that the Cape is too difficult to reach, and the Class is urged to suggest more con-venient locations. Birthdates and the dictates of the medical fraternity relative to reunioners may keep attendance down unless we can locate somewhere near a major airport with accommodations that offer the opportunity for our activities under one roof with a minimum of walking and climbing of stairs.



Members and guests of the Class of 1916 at their 57th Reunion this summer at Chatham Bars Inn on Cape Cod.

The reports of the Secretary and of the Treasurer (shades of Robert Benchley) were read and approved with acclaim. The meeting then progressed into a freewheeling discussion with "Watergate" prohibited. So it developed at once.

Following various other comments and opinions, the Institute came into the discussion. One voiced his pleasure in hearing that ten per cent of last year's class went on to medical school and another seven per cent went into city administration, something that received general approval. Another commented that M.I.T. provides the best premed education that one can have, and that M.I.T. men who have gone into medicine or surgery have been extremely successful. Instances were reported of outstanding young people who had chosen M.I.T. over other highly acclaimed schools in which they had been accepted, both undergraduate and graduate. Some felt that Tech is recovering from the disturbances of a few years ago, yet a few thought the old school "ain't what she used to be". The magnificent 50-year gift of the Class of 1923, around nine million dollars, evoked congratulations but recalled that our 50-year gift, engineered by our Vice President, Joe Barker, was the largest up to that time. Progress begets progress.

Outstanding among the devoted reunioners was Gretchen Gore, who suffered a broken hip in July of 1972 and was hospitalized until just before Christmas. Although John Gore had sent regrets regarding their attending the reunion, Gretchen would have none of it and practiced with her walker for three months to make the trip from Cottage G to the dining room. She made it each time with utter confidence and the admiration of the Class. To add to their problems, a careless bicyclist smashed into their windshield on the first day of the reunion but no serious damage resulted. Nothing lessened their participation in the activities nor dampened their enthusiasm.

Izzy Richmond and Bob O'Brien warmed up on the tennis courts and Izzy's court covering was considered phenomenal for a 1916 graduate. He is still active in architecture and continues to fly solo in

a single engine plane he rents from a local group. . . . Paul Duff, as usual had some piquant stories for us as did Jim Evans, Francis Stern and others of our raconteur department. . . . Dave Patten certainly has made a comeback from the accident that laid him low last year. Both he and Dorothy looked in the pink. . . Francis Stern gloated as usual at their success at the bridge table with the Stones. But he did compliment his bridge opponents as to their performance on the dance floor, rather restricted by a large conference of the Torrington Company's International Sales Force. There was a generation gap between their kind of music and ours. Francis notes that we did have pea-soup fog occasionally which he suggests may be commensurate with the mental condition of the Class. He noted, as did the rest of us, that Walt Binger at 85 has really made a farce of old age, and referring back to the free-wheeling discussions led by Ralph, he commented that this produced the usual outstanding determination that five and five could equal 10, or, if you choose, some lesser or greater number. He, as well as most of us, is in favor of future discussions as meaningless and as enjoyable as this year's.

Walt Binger recalled in a nostalgic mood, the outstanding low comedy event of all 1916 reunions-the twentieth in Saybrook. The finale of a tennis tournament carried on after the clay pigeon shoot and on a high lob one of the nimrods with an itchy finger shot the ball at its zenith. Everyone heard the noise but no one knew what had been shot, least of all the receiver of the lob. He raced forward to put it away, but alas, the ball, full of lead and empty of air, bounced only four inches and the receiver at the end of a terrific swing spun around, lost his balance and sat right down beside it. . . . Jim Evans recalled many events, some not otherwise reported. Herb Mendelson queried about a tennis bat that was woven into the history of past reunions, now a museum piece among the memorabilia at his home in New York City. ... Hildegarde Carr gave an account of the Pennsylvania flood and how her family had suffered in the Wilkes-Barre area-no one who has not been through

it can imagine the devastation. New members were inducted into the Four-Score Club (those qualifying during 1973) in a ceremony with appropriate birthday cake and candles-namely Theron Curtis, Charlie Lawrance, Herb Mendelson, Henry Shepard, Izzy Richmond and Jim Evans. Other notable items: the ladies tearing through Chatham on their annual shopping spree while the boys settled the affairs of the nation: some discussion as to what the Class might do for the 60th to match the red coats we initiated for the 50th.

Several regulars were missing from the last Reunion which prompted the discussion regarding the choice of locale. Several reasons were called from the responses to Ralph's request for intentions regarding attendance. The following pleaded travel in Europe while regretting non-attendance: Rudi Gruber, Doug Robertson and Herbert Pieper. Art Shuey pleaded travel to Senegal, Africa to see the eclipse, noteworthy in itself. . . . Howard Smith was on a world cruise. Ed Parsons was at the Beach and Tennis Club in La Jolla and looked forward to the blue fish and striped bass season in Narragansett Bay from Labor Day on. George Maverick was attending a monster gathering of the Mavericks in San Antonio and Willard Brown couldn't be pried away from Santa Barbara. Allie Jewett, Ted's widow, expressed appreciation for Ralph's invitation to join us.

And now we expect we've run out of space. Do keep the pipeline filled by writing to your Secretary, especially regarding ideas for a suitable place for reunion after the 58th.-Harold Dodge, 98 Briarcliff Rd., Mtn Lakes, N.J. 07046 or Assistant Secretary, Leonard Stone, 34-16 85th St., Jackson Heights, N.Y.

Unbeknown to our President the accompanying picture is shown and the following lauditory comments made. Al Lunn has served M.I.T. and the Class of 1917 well beyond the call of duty. Transferring from Colorado State College where he got his S.B. in 1915 and his M.S. in 1921 he became a loyal son of M.I.T.-B.S.



J. A. Lunn, '17

1917: Harvard B.S. 1917: Colorado State College honorary Ph.D. 1956. He was one of few in the Class to get degrees from M.I.T. and Harvard simultaneously. He spent many years with Dewey and Almy Chemical Co., and is a recently retired vice president of the Kendall Co. In retirement (so called) Al has served as a director of numerous companies, notably the American Research and Development Co., and continues to serve several. His alumni activities began in 1928 on the Alumni Council, then to the Executive Committee and was President of the Alumni Association in 1950. Since that time he has served a term on the M.I.T. Corporation and has been a member of numerous Institute and Alumni committees, notably the chairmanship of the Long Range Planning Committee.

When Buzz Aldrin made his historic Gemini 11 flight Al alone conceived the idea of a Buzz Aldrin Scholarship Fund for Aeronautics and Astronautics knowing well the pressing need for scholarship funds. A goal of \$100,000 was set in 1967 and it is due to Al's diligent leadership that inspired several and all to complete the Fund. He has been asked to make the following report.

"We have good news for you-the 1917 Buzz Aldrin Scholarship Fund has exceeded objective at \$103,559.76. This was accomplished without using any accrued interest for this fiscal year. I want to thank personally every member of the Class who helped make this possible.

"We are asking for representation on the 1917 Aldrin Fund Committee and are requesting that: 1) An Aldrin scholar be designated each year but not requiring that the entire income be allocated to him. 2) The Class be represented on the Committee. 3) Descendants of the Class of 1917, if available, be given preference.

'The 1917 Memorial Scholarship Fund has reached \$100,195 and the income can now be distributed for scholarships without regard to Course or subject area. Again we request that descendants of the Class of 1917, if available, be given preference. These two funds will now produce about \$10,000 annually for scholarship use."

In June of 1972 on Alumni Day, Al made a report for our 55th anniversary. It is worthwhile to repeat that report. "The members of the Class of 1917 have always been innovators. They have supported their Alma Mater in original and imaginative ways.

"In addition to their financial contributions to the Institute, they have given generously of themselves. They produced two deans, numerous members of the Faculty and Administration, five members of the M.I.T. Corporation, three presidents of the Alumni Association, three members of the Long Range Planning Committee of the Association, many members of corporation visiting committees, numerous members of other important committees and important representives from the Institute on government agencies.

"At the 25th Reunion, the Class presented to the Institute a wasting scholarship fund and a service boat to the M.I.T. fleet—the 'Horace G. Ford'. Our 50th Year Reunion gift was the largest of any 50th Class to date. On our 51st year, the widows of the Class gave the painting of 'Old Rogers' hanging in the President's office. This was certainly an in-

novation.

'Our 55th Year Reunion gifts are, we believe, innovations also. At our 30th Reunion, the Class started an insurance fund which we hoped would be the nucleus of our 50th year gift. It never proved big enough to satisfy our ambitions so some time ago we decided to make it the 1917 Memorial Fund when it reached \$100,000—we present this \$100,000 Capital Fund today, with the income to go to M.I.T. on an unrestricted basis.

"We have another gift to present today. When our illustrious honorary classmate Buzz Aldrin landed on the moon more than two years ago, we decided to endow a 1917 Buzz Aldrin Scholarship for Aeronautics and Astronautics at M.I.T. Our objective is to raise \$100,000 for this endowment-the income of which will go to this purpose. We are happy today to make the down payment of \$80,868. "These gifts represent our strong faith in the Institute and our highest hopes for

Alumni Day brought several of us together for the various interesting and well-planned events. Those present were the Dennens, Dunnings, Hunters, Lunns and the Ray Stevens with Brick Dunham and Stan Lane. A copy of the "Meloy News" reveals that President Tom Meloy received the National Capital Award from the Washington Council of Engineers and Architects in recognition of his highly successful career of over 50 years in a broad range of activities which raised him to the highest executive position of Columbia Machine Works, Melpar, Codex, Isomet and Meloy Laboratories. It also shows a picture of Tom's son, Dr. Thomas P. Meloy, who is Vice President of Research and Development of Meloy Labs.

Frank Butterworth advises that George Henderson, Captain U.S.N. (Ret.) has been having eye surgery at the Naval Hospital in San Diego. . . . "Dutch" Neuman is semi-retired from his construction business in Des Moines. He fills in some of his time as a member of a sketching

club and goes to the country Saturday afternoons. He likes pen and ink and reports that he has been doing it for years but gets no better or worse. . . . An omission was made in the last January Notes when Bill Dennen was not included among those '17ers who has served as Honorary Secretaries. Bill was appointed in 1939 and served for many years.

The interest created by Dud Bell's acupuncture treatments led to a request to Dud for further word. He reports;" I had the eighth acupuncture treatment two weeks ago, July 9. This time it was somewhat different in that eight needles were inserted into each leg. This is not painful although I knew they were put into the flesh, about one and one-half inches. The electric vibrator was attached and after a half hour everything was removed. During the treatment I felt little pain.

"When I left, my legs and movement seemed better although I felt sure from previous experience that the next few days would allow for restrictions and pain all over again. This occurred, but gradually the pain disappeared and my leg movements were better. It seems to me that the process is rather drawn out and that my original, deteriorated condition is by no means quickly eliminated. I have records that show that the number of treatments vary with patients. Some have as many as 70 before complete improvement. I am hoping that my case will be much less. I should mention that in all previous treatments four needles in each leg were the limit. My doctor had just returned from a few weeks in China where he had more instruction. The eight needles in each leg were well distributed-two were seven or eight inches above the knee, two just above the knee, and the other four distributed in pairs to the ankle. So my situation is fair and improvement seems certain."

Dad Wenzell continues to live in Washington with considerable time spent at the Onteora Club near Tannersville, N.Y. They had a month in Northwest Spain last year. . . . Tubby Strout, Al Lunn and Ray Brooks had their usual June luncheon in Falmouth, Mass., where Ray has spent the month of June for years. Tubby keeps busy in Osterville with his garden and the local men's club. . Stan Lane was designated "Baptist Man of the Year" and received a plaque at the 82nd annual meeting of the Baptist Home of Massachusetts. Charles Gager advises "Still go to the summer cottage at Groton, Conn. My daughter Nancy Gager Clinch is author of new book The Kennedy Neurosis."

The Earl Lewises vacation in Mexico and he is working full time as consulting engineer at the Polaroid Co. . . . Win Swain "seems to be increasingly prone toward rationalization as the years roll on, not only with respect to my physical being but as to investment judgment in this short view stock market. So I am going back to the farm for the month of May." Ray Blanchard has a new address, 180 Kennedy Dr. #212, Malden, Mass. 02148. . . . Chet Ames has also moved and is now at 1 Pond St., #100, Winthrop, Mass. 02152. . . . Leslie Ford has a new address 12 North Dr., Marion, Mass. 02738

With regret the deaths are recorded of Harold M. Brayton on April 23, 1973 at Oak Ridge, N.J.; Gale D. Geopfert on February 7, 1973 at Lake Worth, Fla.; and Roswell E. Pfohl on March 1, 1972 at Buffalo, N.Y .- Stanley C. Dunning, Secretary, 6 Jason St., Arlington, Mass. 02174; Richard O. Leongard, Assistant Secretary, 21 East 87th St., New York, N.Y. 10028

During the first weekend of June, we had our 55th Reunion at Chatham Bars Inn on Cape Cod. I am happy to report that this get-together was most relaxed and pleasant with a cementing of spirit through a renewal of friendships, realizing a new high in class loyalty. The attendees included Jim Bugbee, Fred Philbrick, Phil Craighead, Nat Krass, Robinson Rowe, the John Kileys, Jack Poteats, Pete Har-rells, Charles Taverners, Mal Babers, Max Seltzers, Julie Howes, George Sacketts, Harry LeViues, Tom Brosna-hans, Leonard Levines, Julie Averys, Sax Fletchers, John Kilduffs, Eli Bermans, Herb McNarys, George Brewers, Craig Hazelets, and Charles Watts.

We are indebted to Len Levine for the following two interesting reviews by Bert Jones and Jack Poteat. "Dear Leonard, It is possible that I am the Bert Jones you say you used to play ball with, but after looking at a picture of the 1918 team in my copy of the 1917 Technique, somehow I did not see your picture in the group. Where were you? I remember some of the boys, such as Bunny Gleason, Spooner, and some of the pitchers.

"So you retired and then gave up retirement. I thought about that in 1959, but after a thorough medical check-up, I asked the M.D. if he would advise that I quit work. This was his answer, "That is the last thing in this world you should do-quit work; your system is geared for action. If you should quit work, you wouldn't last two months. So whatever you do-keep going, but slow down and be your age." After all, I am only 81, now. I retired from one job and took another.

"Again, I see they are going to Cape Cod for their reunion. That used to be my favorite hunting ground. From 1950 to 1965 I had a 42-foot double cabin cruiser which I kept in Hyannis in the winter and anchored at my mooring in Cotuit harbor in the summer. That was my summer home.

'On another occasion I remember President Kennedy came into Cotuit harbor and dropped anchor about 50 feet away. Between the coast guard, the police boats and the associated press boat, I

was completely surrounded.

"So you finished Course II. I finished Course V supposedly as a teacher of chemistry. This is how come. Years ago, when I was in high school, Mary McLoud Bethune, the founder of Bethune-Cookman Institute in Daytona Beach, Fla. was canvassing the country for funds, the same time Booker T. Washington was doing the same for Tuskegee; she was a friend of my step-mother, so whenever she came to Boston, she always stayed at our house. She used to tell me about her struggles, and one of the great shortages she stressed was that of teachers at that time. She was the one who put the idea in my head, and promised that she would always keep a place for me any time I became available.

'The day after I left Tech, I found myself in the army. When I left the service I had decided not to go to Florida and gave up the idea of teaching.

"I had finished pharmacy in Boston before I went over to Tech and thought I would give it a try. So here I am still stuck with it. With kindest regards, Bert."

We have a second letter from John R. Poteat who writes, "To me it seems amphigoric and not a little nonsensical to think that anyone would be the least bit interested in what happened to me after I left M.I.T. in March 1918 to go into anti-submarine service with the navy. While at our 55th Reunion you met one result of my navy stint, for while in New London I met a girl at Connecticut College who became my wife after she graduated and after I had been hired by a Boston engineering firm. I was with Lockwood Greene Engineers for eight years and while with the New York office an assignment in Peru gave my boss an opportunity to present me and my new wife with our honeymoon trip to that South American country. My final job was as Manager of the Chicago office from which I resigned in August 1927 to join Hotpoint, a subsidiary of General Electric.

"Before I resigned I had prepared a letter about my qualifications to various corporations and the reply which appealed to me most was with Hotpoint and thus began my 31 years association with General Electric.

"After 5 years in both factory and sales departments with Hotpoint the parent company decided to re-enter the electric range business with a G.E. brand. I headed up this new operation. At that time it was decided by G.E. to broaden the product line of the independent distributors who had only the GE refrigerator to merchandise.

"The headquarters for GE of refrigerator distribution was in Cleveland so we were moved there. It was at the depth of the depression in 1933 and so range sales were very disappointing. Later when a consolidation of all G.E. appliance business, large and small took place, we were moved to Connecticut with headquarters in Bridgeport.

"In 1951 Appliance Park was established in Louisville, Ky., after another man and I, in a country-wide canvas to find a suitable place for such a plant, had recommended the Kentucky city. A range plant was set up as an independent operation with sales, engineering, manufacturing and financial departments to manufacture and sell G.E. brand ranges. I was fortunate because I had very superior men to head up the several departments of the operation and it was through their efforts that in less than 10 years it became the largest "cook stove" manufacturing plant, in the world.

"I had the happiest relationship with the people in my organization, including those in the factory as well as in the other sections of the operation. Innovations were constantly being developed.

"The opportunity to live in numerous communities has been a great advantage. It developed a wide range of friendships as well as a variety of community involvement that are most rewarding. My interest in music brought me the presidency of the Louisville Symphony Society into which I was able to inject some company support. And since retirement I have been Chairman of the Brevard Music Center and President of the Blue Ridge Assembly, the conference center for the Y.M.C.A.'s of the 10 southeastern states. All of which goes to show that retirement doesn't have to be an idle time-I seem to have been busier than I was the last two years of my active business life. And aside from service on several boards at present, there is time for golf, music and the joys of delightful friends. So the goose hangs high and life is worth living."

Tom Brosnahan is busy as usual as a consultant on chain store operations. In particular, I have a copy from him on the "Comparison of Operating and Financial Characteristics of Selected Mass Retailers" for one of the trade papers. He is working on a book on his world travels.

We are continuing our mini reunions which we have enjoyed during the past three Octobers. Once again, it will be at Endicott House, Dedham, Mass., Sunday, October 21. We hope that all of you will make a special effort to participate in a most delightful occasion. Members of the classes of 1917 and 1919 are invited to join us on this day. Our guest speaker will be M.I.T. Vice President, Kenneth Wadleigh.

Mal Baber writes that he was in an accident several weeks ago and sustained a broken vertebra in the back. By this time, he expects to have a brace and resume activity. Hope you are fit, Mal, and that we will see you soon at our mini reunion. . . . Len Levine posted a card from Hotel Wentworth, Portsmouth, N.H. From here, he continues on a ten-day cruise to Quebec and Montreal before returning to teaching in Boston. . Georgius Cannon entertained our genial Alumni Secretary, Dick Knight, when he passed through Salt Lake City, recently. Georgius is anxious to have any of us stop when visiting in that area. Dick notes it will be a most enjoyable experience for Georgius knows his Salt Lake City and is a most gracious host. We note with sadness the passing of Walt Biggar as reported in the Burlington Free Press, June 25. Our condolences go to his widow. Colonel Biggar served in the army in World War I and II and retired from the Army Reserves on March 31, 1956.

After leaving the army he was institutional representative in western Massachusetts for the J. I. Holcolm Manufacturing Co. of Indianapolis, Ind. He was graduated from M.I.T. and also held a degree from Harvard University.

He leaves his wife, Dorothy Adams Payne Biggar of South Burlington; three daughters, a sister and a brother.

We report address changes as follows: Howard M. Cyr, 477 Donora Blvd., Ft. Myers, Fla. 33931; Charles Dow, R.F.D., Londonderry, Vt. 05 Vt. 05148, Thomas M. Knowland, 53 Hill Rd., #411, Belmont, Mass. 02178; Edward N. Little,

61 Ivy Lane, Englewood, N.J. 07631; James W. O'Brien, 1630 Lake Ave., #1, Normandy Park South, Clearwater, Fla. 33516; Wendell P. Monroe, 7724 Beland Ave., Los Angeles, Calif. 90045; Dr. John B. Nelson, 498 Stockton Rd., Princeton, N.J. 08540 .- Max Seltzer, Secretary, 60 Longwood Ave., Brookline, Mass.; Leonard Levine, Assistant Secretary, Assistant Secretary, 519 Washington St., Brookline, Mass.

Dean Webster, Will Langille, "Burly" Burbank and Gene Smoley attended the Luncheon on Alumni Day June 4 at the Institute. The 55th Reunion came under discussion. It was good to get back to M.I.T. if even for one day. . . . Your Secretary left for Europe and spent six weeks in Scandinavia and U.S.S.R. in

June and half of July.

Robert S. Bolan reports his address as 2030 E. Leewyn Dr., Sarasota, Fla. 33577. . . . A note from Elliot D. May states that he is just recovering from a severe heart attack. . . . Ray H. Bartlett writes, "My wife died January 16, 1973 after a long illness. We had been married for 54 years. It takes awhile to pick up the pieces and I am using golf as a sedative. Two children and five grandchildren through visits and correspondence are trying to keep me occupied." . . . Lester Wolfe has just been named a founding member of a newly-formed group of advisors to the Rockefeller University. He is President of William J. Rountree Co., Inc., of New York City. Lester took post graduate work in Aeronautical Engineering at M.I.T. in the field of Naval Aviation. In World War II he was a commander in the navy and worked on aircraft instrument development with emphasis on development of gauges for fighter planes. He is also President of the Lester and Kathlyn Wolfe Foundation, dedicated to furthering basic research in molecular biology.

This council, to have at least 50 members from all sections of the U.S. and internationally will hold full-day meetings once or twice a year at the Rockefeller University's York Avenue campus. The object being to become informed about basic research in biomedical sciences and related behaviorial and physical sciences, the clinical work of the University's hospital and educational programs at the predoctoral and postdoctoral

levels.

The Alumni Association reports the death of E. Russell Hubbard, P. O. Box 853, Pinehurst, N.C. 28374 on May 6, 1973, and of John J. Hanson, 374 Lincoln Ave., Cranford, N. J. 07016 on November 28, 1972. . . . A report has been received that Lawrence G. Ropes, 218 Alcazar Ave., Coral Gables, Fla. 33134 passed away on May 28, 1973.

The Portland, Maine Press Herald and the Sentinel carried on May 3 the obituary of Retired Air Force Major General Edmund W. Hill who died on May 1 in a Boston, Mass., hospital after a brief IIIness. He had retired to Belgrade Lakes, Maine. He had a distinguished military career spanning both World Wars. He

held many military medals and honors. From 1937-1941 he commanded Bolling Field in Washington, D.C. He was in charge of air operations at the Yalta and Potsdam conferences and established air forces in Berlin. He was head of the air section of the U.S. Mission to Moscow and was the Commanding General of the U.S. Air Force in the U.S.S.R. from December 1944 to May 1945. Since his retirement in 1946 he was engaged in the life insurance business with Government Personnel Mutual Life Insurance Co. He is survived by his second wife, Mrs. Mildred Cary (Eaton) Hill whom he married in 1962.-E. R. Smoley, Secretary, 50 East Rd., Delray Beach, Fal. 33444

At the annual gathering of Alumni last June your Secretary welcomed an opportunity to apologize to Lois Des Marais for omitting mention of her in the class news. Not having heard from George of the fact that he and Lois were on their honeymoon at the Mexican Fiesta I deemed it discreet to mention that George had attended. They both understood and I must say that Lois graciously accepted my plea of ignorance. George tells me that they actually advanced the date of their wedding in order to attend the Fiesta and were very glad they did. Says George, "I cannot recommended too strongly to any of our classmates who enjoy travel and good fellowship that they take in one of these annual fiestas. We had the pleasure of spending time with Maxine and "Cac" Clarke, '21. He and "Count" Dumas were awarded Eager Beaver citations for attendance of four years. The Count and his lovely mate, Evangeline, have been wintering in Cuernavaca for a number of years." Trust the wise, old Count to duck those frosty winters in Quebec.

Present at one time or another on Alumni Day, besides Lois and George, were Betty and Al Burke, Beth and Ed Ryer, Phil Wait, Ruth and Elbridge Wason, Perk Bugbee, and, of course your Secretary and his Amy. I am sure I need not mention my appearance at the "Pops" since my shining, old bald head is visible to keen-eyed classmates who saw the picture on page 113 of the last issue of the Review. . . . That was a nice picture of Norrie Abbott in the Providence Journal on the occasion of his retirement as deputy for the Rhode Island Masons to the Supreme Council. Norrie was shown for youthful contrast chatting with a 101-yearold member.

"Mac" Maconi writes to correct an error in the spelling of his new wife's name which should have been Calista-"K" for short. The Maconi's took off earlier in the summer for Vancouver, stopping to see the Columbian ice field and Lake Louise once again. In Vancouver Frank visited Howard Simons, '22. A note from Skeetz Brown registers the point that his home address is Colonia Miramonte 68, Scottsdale, Ariz., his summer address from July to October, is 8111 Camino del Oro, La Jolla, California-and classmates are always welcome at either address. . . . Art Merriman has an interesting comment about the big nuclear power plant constructed on Lake Erie not far from his home in Cleveland Heights. Its eventual operation is being fought in the courts by environmental protectionists and Art, aware of the power crisis, is keenly interested in the outcome. He should compare notes with Peck Bugbee whose home is nearby the nuclear plant at Plymouth, Mass. Art conveys the good news that he and his wife, Mayhew, remain in good health and are looking forward to the 1975 Reunion.

Recent addresses for our ever-volatile Class include: George W. Anderson, 5 Hamilton Ave., Berkley Heights, N.J.; Charles E. Packard, 501 So. Center, Ashland, Va.; Stan Reynolds, 200 East End Ave., N.Y.C.; Scotty Wells, 1379 Trinity Park Dr., Louisville, Ky.; Will Boyer, 368 Club Dr., San Antonio, Texas; Ray Reese, 3821 Sulphur Spring Rd., Toledo, Ohio.

Word has been received of the death late last year of Vice Admiral Arthur C. Miles of 1679 Los Rubles Ave., San Marino, Calif. No further information at this writing.-Harold Bugbee, Secretary, 21 Everell Rd., Winchester, Mass. 01890

After almost three month's vacation from writing Class Notes, I feel out of the groove. Alumni weekend was inspiring, educational and fun for your Secretary. It was a two-fold affair. It was Betty's 50th Reunion at Simmons and husbands were invited. Who did our nextdoor neighbors in the Simmons dorms turn out to be? Hazel and Whitney Wetherell, up from Cape Cod! At dinner that night a charming young lady leaned over our shoulders and said, "You're the Haywards, aren't you? I'm Barbara Lloyd Hayes, Emma and Al Lloyd's daughter." Barbara was seated at the head table as Co-Chairman of Simmons Alumnae College "Education Update", an excellent educational program presented that Friday evening and Saturday morning by students and faculty. Tech Night at Boston Pops was as delightful as ever and '21 had several tables in the front row as evidenced by the photograph in the July/August Technology Review. Attending Alumni Day were George Chutter, Maida and Ed Dubé, Ed Delany, Betty and Sumner Hayward, Irving Jakobson, Mel Jenney, Emma and Al Lloyd, Bob Miller, Elma and John Mattson, Elizabeth and Don Morse, Catherine and Phil Nelles, Gladys and Paul Rutherford, Helen St. Laurent, Anne and George Schnitzler, Bill Sherry and Lovina and Ted Steffian. There was a wonderfully amusing lecture in the morning by Doc Edgerton, the traditional luncheon, a fine panel presentation in the afternoon and the final social hour in duPont Gymnasium making it a memorable day.

George Schnitzler put on a private showing in McCormick Hall after luncheon, of slides taken at our 50th Reunion. These are excellent slides, and thanks go to George for bringing in a projector and showing them to the '21 group. George reports that he and Anne are planning to move permanently from Massachusetts to Florida and after November 1, his ad-



Alumni Day's cocktail hour brought together these '21ers and guests: from left to right: (seated) Helen St. Laurent,

Emma Lloyd, Betty Hayward, Ed Dube, Elma Mattson, Maida Dube, Anne Schnitzler, Lovina Steffian; (standing)

Ted Steffian, Bill Sherry, Al Lloyd, living Jakobson, George Schnitzler, Sumner Hayward, John Mattson.

dress will be 1098 Venetian Way, Miami, Fla. 33139. . . . Lou Mandel is another Northerner who has sold his apartment and moved permanently to Miami. . . . Driving into Boston on the Massachusetts Turnpike, Helen St. Laurent pointed out all the missing windowpanes now covered by plywood in the Hancock Building.

Ted Steffian told us his theories at lunch about the glass blowing out and that M.I.T. has a consulting contract to find an answer. Ted's architectural firm is working on a study for rehabilitating and improving Harvard Square. He himself has taken up painting in watercolors again and we hope he will give us a oneman show some day. . . . Bill Sherry reported that Bill, Jr., who came as a boy to one or more '21 Reunions, served over two years in Vietnam and is now Executive Director of the Oklahoma Alcoholism Council. Bill, Sr., had a short bout with surgery this spring but seemed in fine shape. . . . The Don Morses reported staying in Naples, Fla., last winter. The 1921 contingent in Naples seems to be growing. . . . Inquiring from another Naples' resident, Ed Delany, about Garvin Bawden, we learned that Mich was in Duxbury, Mass., for the summer. A letter from Mich told of his buying a smaller house in Duxbury at 94 Prior Farm Rd. His health has not been too good this past year so that he uses a wheelchair to get around. He and Helen also own an apartment at 35 North Gulf Shore Blvd., Naples, Fla. 33940, their official address.

Letters received from Sam Lunden, George Chutter and Bob Miller told of meetings of the Cape Cod '21ers in late May and June. As Bob Miller's guest, San Lunden was asked to address the Orleans Coffee Club, a group of over 100 men, on the subject of traffic and transit problems in the Los Angeles area, including a discussion of the new generation of rapid transit systems. Sam was introduced as an expert but contends this title simply means he comes from another part of the country. Actually he has served on two civic transit committees and as Vice Chairman of one, and has designed intra-city systems referred to as People-Movers. Also in his audience at the Coffee Club were Don McGuire and Whitney Wetherell. Sam attended his wife Leila's 50th Reunion at Boston University in May. Leila graduated from Sargent College, now part of Boston University, Sam has just been ap-pointed to his third three-year term on M.I.T.'s Corporation Development Committee.

The Chutters were hosts for a pot-luck supper, the middle of June which included the McGuires, the Millers and the Wetherells. Said George, "We all had the foresight to marry good cooks so the luck was excellent." Don McGuire brought along scores from three Tech Shows and Bob Miller had some new slides to show, so there was a sight and sound accompaniment to the good food. . . . Shortly after the pot-luck supper, Helen and Bob Miller returned to their apartment in Silver Spring, Md., stopping briefly along the way at the Lloyds' in Westerly, R.I., the Haywards' in Ridgewood, N.J. and the Clarkes' in Brielle, N.J.

Your Secretary learned on Alumni Day that Lawrence W. Conant of Washington, D.C., was engaged in some original research on what might be called "far-out physics." Larry, a graduate of Course XV, worked for many years in various departments of the Federal Government and since retirement has been a Consulting Cybernetician. A letter to him brought a reply which confirmed his current involvement. We quote briefly from Larry's letter and a paper which he published, entitled, "Time-Space—A Cybernetic-Thermody-namic Dimension." "For years my study of cybernetics has led to this conviction: we can and should specify mass otherwise than as a certain metal cube-this

will require a new mass-less unit; it must involve no mass at all. Mass-less motion rather than mass in motion is the initial, primarily originating, concept of the structure of the universe. I arrived at a conclusion that the universe is divided into two distinct categories of systems. One of these, scientist Dewey Larson identifies as Time-Space, the material sector and the other as Space-Time, the cosmic sector of the universe." Our thanks and admiration go to Larry for his erudite

In connection with assembling photographs for the Buckner-Miller montage, Bob Miller received a newsy letter from Lieutenant General Daniel Noce, Covington Farm, Sperryville, Va. 22740 (new address). General Noce wrote that he sees Major General Stanley L. Scott of Alexandria, Va., occasionally and "General Scott looks OK." Both generals came to our 25th Reunion at Osterville but didn't make the 50th. General Noce retired in 1954-goes frequently to visit six grandchildren in Barnstable, Mass., and has been a "dirt farmer" in Virginia for 20 years.

A letter from Ralph Shaw, Jr., states that in June he subscribed for a slug of Mas-sachusetts tax-free M.I.T. bonds due in 1996. He wonders if other members of the Class have done likewise. Write Rufe for further details. He is still working and writes of recently selling one of his machines to the Trucial States of Arabia. The Shaws had a busy summer planned which included taking children and grandchildren to Hawaii. Said Rufe, I should be poorer by Labor Day.'

Sadly we record the death of three of our classmates, Earl H. McBroom of Pasadena, Calif., on June 30, 1972, Willard G. Loesch of Rocky River, Ohio on June 18, 1973 and Harry P. Field of Honolulu on August 7, 1973. Josephine Loesch wrote that she and Bill had such a happy time at our 50th Reunion. Bill

was a former vice president in charge of production for Forbes Varnish Co., of Cleveland, for whom he worked for 40 years. Harry Field had been ill for several years and for this reason was unable to attend our 50th Reunion although he had attended a number of previous reunions. He spent most of his career working for the Hawaiian Electric Co., from which he retired in 1958 as Vice President and Commercial Manager. The sympathy of the Class is extended to the families of all three classmates.

A nice note from Larcom Randall of Sarasota, Fla., in June told of his wife Catherine's breaking a thigh bone in their living room while doing a solo dance to Lawrence Welk's music. Because of required surgery and a long convalescence, their summer trek to Lake Winnipesaukee had to be cancelled. Fortunately the Randalls had had a "wonderful Caribbean cruise" shortly before the accident.

Irving Jakobson took his customary three-week summer cruise along the coast in August and sailed as far as Vinalhaven, Me., where he spent an afternoon and evening with Helen St. Laurent. He reports that he and his sailing crew had a delicious lobster supper at Vinalhaven. Jake also had a pleasant visit with Beth and Whittier Spaulding in Boothbay. The Spauldings have bought a house in Sarasota, Fla., only a few hundred feet from Claudia and Josh Crosby so they will be winter neighbors of both the Crosbys and the Tom Duttons.

A number of messages have come in on Alumni Fund envelopes and will be reported in the next issue. . . . A final brief: This morning's New York Times August 17 reports that John W. Barriger has been retained as a special assistant to John Ingram, Federal Railroad Administrator. John is also a railroad management consultant for Ford, Bacon and Davis, Inc.

Have a good fall!-Sumner Hayward. Secretary, 224 Richards Rd., Ridgewood, N.J. 07450; Josiah D. Crosby, Assistant Secretary for Florida, 3310 Sheffield Cir., Sarasota, Fla., 33580; Samuel E. Lunden, Assistant Secretary for California, Luden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013

Writing Class Notes from Buffalo for the fall is refreshing because of the beautiful sunny 80 degree weather we have had all summer, cooled by the balmy breezes of Lake Erie. Both sailing and golfing have been just perfect. We have an open space in our Notes hoping for reports from classmates regarding the June 4 Reunion. Those attending included Parke Appel and his wife Yardley Chittick, Earl H. Eacker, Warren T. Ferguson, Julian Lovejoy, C. Randolph Myer and his wife, Marjorie Pierce, Win Potter, Fearing Pratt, Samuel H. Reynolds and Karl Wildes. On that day your Secretary was flying from Stockholm to London to New York and found it inadvisable to put down in Boston.

Colonel and Mrs. Ray C. Burrus celebrated their 50th anniversary on June 27 by announcing the marriage of their son in St. Louis on that same day. All our best wishes go to the two couples. Norman L. Appollonio of Camino, Calif., writes that he is finding "gold in my quartz ledge which, during the past 40 years has failed to make me rich in peas farming." He hopes to help provide a new swimming pool near McCormick Dorm where he enjoyed the 50th Reunion with "Superman Parke Appel"... A nice note from C. Yardley Chittick tells of his retirement from his firm to a new address of R.F.D.-1, Ossipee, N.H., 03864. . . . We have also heard of the retirement of Walter L. Gorden of Livermore Falls, Maine. . . . John J. Cychol has reported his latest exciting happening as being rushed to the hospital with a ruptured appendix. It was hot as a furnace and very painful. . . . L. Sam Vadner has written his opinion in forceful language on a current political item. We hope that Sam's tennis is still in good form. . . . Paul S. O'Brien is going to Belgrade, Yugoslavia to lecture on the subject "Responsibility of Changing Attitudes" at the conference of International Council on Alcohol and Addictions. The President of this organization is U.S. Senator, Harold E. Hughes of lowa.

We are happy to note that two of our classmates attended the 25th anniversary at the M.I.T. celebration in Mexico City in March. Participating were Helen and Edward A. Ash of Olmstead, Fla., and Katherine and Dale Spoor of Richmond, Va. From the good reports an-nually received, more of us should join

in this celebration.

Among the new addresses received was that of Samuel I. Zack, Harrisburg, Pa. We are sorry to hear of the death of Dexter Shaw on July 25 in the Bryn Mawr Hospital. Walter Sanders of Cape Elizabeth has written of Dexter's continued interest in his firm of patent lawyers in Philadelphia. He leaves his wife Edna and brother, E. Tyler and two daughters. . . . Our sympathy is sent to the families of Dr. Preston Robinson, scientist and engineer, who designed the energy storage capacitors that triggered the first atomic bombs. He was a retired executive of the Sprague Electric Co., in North Adams. He held 114 patents including the basic one for solid-electrolyte capacitors. . . . We are sorry to report the death in April of Paul M. Kellogg of Linfield Center, Mass. He was a former resident at Pemaguid Point. . . . We also report the death of Robert Sanders Coupland, Jr., who died at Metairie, La. in June after a long illness. He had been practicing architecture in New Orleans for almost 50 years.

Unfortunately, our Class of '22 is getting smaller and older. But as long as our tennis players inspire us bench-warmers, we'll still meet for reminiscences at

M.I.T. and have fun.

Fearing Pratt, free lancing as temporary third assistant interim reporter, for the class at Alumni Day recalls that the class round-up was chaired by Prexy Parke Appel and Madeline at the luncheon. . Yard Chittick came down Route 16 from Sanbornville, N.H., his new permanent residence. Minor medical attention prevented Ruth from coming. . . Buck Eacker was there from his summer resident in Annisquam, Cape Ann. Buck's son, James H., '55, was Alumni Day Deputy Chairman. We all missed Peter. . . Warren Ferguson of Watertown, Mass., delayed a short sojourn to Florida to attend. Julian Lovejoy, recipient, (as well as yours truly) of a Pioneer Radio Amateur Award from the late Herbert Hoover, Jr., interrupted radio "haming" long enough to attend from Manchester, N.H. Randy Myer-without his winter skiis-and Mrs., were there. Regular attendee, Marjorie Pierce, a member of the Alumni Fund Board, received assurance of generous gifts from all. . . . Hal Baker, prominent resident of Portland Head, Maine, express-bussed to our luncheon and returned the same day. Others seated about the round tables with a '22 centerpiece were Sam Reynolds, Karl Wildes and Ted Miller and his wife.

It was gratifying to note that Margaret L. A. MacVicar '64, our class assistant professor, spoke as one of the principal speakers at the Kresge afternoon seminar on "Undergraduate Research Opportunities Program." Parke told us of the interesting dinner which he and Don Carpenter gave for our class professors, John Wulf, Paul Gray, and Roy Lamson. Professor Margaret MacVicar was unable

Local responsibilities prevented Tommy Thompson from leaving California until after Alumni Day. Ab Johnson, Dottie, and Frank Kurtz were too busy packing for their North Cape cruise-they departed a few days later. . . . Eacker visited Ross Sherbrooke in Cohasset the next day and was assured by him, that he would surely attend the next Alumni Day. . . . Win Potter, without his seeing eye movie camera, was with us later at the social hour. . . . Oscar Horovitz, renowned amateur cinematographer and the esteemed Assistant Class Secretary, would have attended if his new granddaughter-in-law had not planned her wedding for that day. Classmates attending the popular Pops were gratified to see Arthur Fiedler, conducting, still attired in our 1922 Class 50th Reunion cardinal jacket. He also wore it at the summer Tanglewood Concerts, also at Sarasota, Fla., and the Boston TV Channel Two Auction.

Since these events I have talked with Don Carpenter who is now at his summer port of West Chop, Vineyard Haven after having brought Little Dipper II up from Georgetown Chesapeake Bay through the fog by R.D.F., (radio director finder for those on the beach). For myself I have just returned from cruising Down East, east of Penobscot Bay helping to punch holes through the fog along the Maine coast, with the aid of some barking dogs on the shore and keeping clear of the racing New York Yacht Club \$4,000 per foot sailing machines. . . . Mac McCurdy would not have been able to see the bow of his ninety-six-foot Blue Peter in the pea-soup fog.

Coming up-our 55th Class Reunionsaid to be at the Spaulding Inn, Whitefield, N.H.-Whitworth Ferguson, Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; Oscar Horovitz, Assistant Secretary, 3901 South Course Dr., Pompano Beach, Fla.

The 50th Reunion of the Great Class of 1923 got under way in good shape on Thursday afternoon, May 31, with registration at the Marriott Motor Hotel in Newton. By the 6:00 p.m. cocktail hour all but a few of the 149 whom we expected had made contact and we were officially off to the races. From this point on until the following Monday afternoon I think I can say that there was hardly a dull moment and that everyone had a great time. The Gray Line busses ran almost on schedule, no one got lost and everyone had a vacation from traffic jams and parking problems. Bus captains Russell, Lange and Lund did a great job and Officers of the Day, Rounds, Mapes, Pennypacker, Burke and Bond, had no problems as no one "took sick" or had a bad case of the vapors. Also no one got really mad at Tom Rounds-this was duly ap-

preciated. The following attended the Reunion in whole or in part: Alan R. Allen, W. P. and Mrs. Allis, F.O.A. and Mrs. Almquist, K.S. Andem, E. M. Barnes, L. E. Barstow, J. W. and Mrs. Beretta, W. H. and Mrs. Blandy, H. L. and Mrs. Bond, H. A. and Mrs. Bruson, C. T. Burke, G. W. and Mrs. Bricker, M. L. and Mrs. Carey, C. V. and Mrs. Chamberlin, M. N. and Mrs. Clair, H. L. and Mrs. Cobb, R. T. and Mrs. Colburn, P. L. and Mrs. Coleman, A. W. and Mrs. Davenport, Louis and Mrs. Domingues. Howard Doster, T. B. and Mrs. Drew, Ben and Mrs. Drisko, C. H. Ducote, Bernardo Elosua and guest, G. A. and Mrs. Fitzgerald, R. H. and Mrs. Frazier, R. M. and Mrs. Goetchius, H. B. and Mrs. Gray, Harry and Mrs. Green, E. L. Greenblatt and guest, W. B. Greenough, Jr., E. A. and Mrs. Griswold, H. L. and Mrs. Hayden, Robert and Mrs. Henderson, Joseph and Mrs. Hetzel, Ray and Mrs. Holden, D. B. and Mrs. Joy, David and Mrs. Kaufman, K. C. and Mrs. Kingsley, R. C. and Mrs. Kleinberger, E. P. and Mrs. Knight, W. S. and Mrs. LaLonde, F. F. Lange and two guests, Arne Lier, K. C. Linn, H. A. and Mrs. Lockart, J. S. and Mrs. Loewus, O. W. and Mrs. Lowry, J. Y. and Mrs. Lund, B. A. and Mrs. McKittrick, C. M. and Mrs. Mapes, E. H. Miller, C. E. Mongan, J. C. O'Flaherty, M. O. and Mrs. Orwin, Miles Pennybacker and guest, J. A. and Mrs. Pennypacker, L. H. and Mrs. Poor, A. J. Pyle, A. S. and Mrs. Redway, J. A. and Mrs. Robbins, R. C. and Mrs. Robin, Isadore and Mrs. Robinson, Charles and Mrs. Roche, T. E. and Mrs. Rounds, G. A. and Mrs. Rowen, H. F. Russell, Powell and Mrs. Robinson, E. H. and Mrs. Schmitz, D. W. and Mrs. Skinner, R. H. and Mrs. Smith, J. A. and Mrs. Stratton, Royal and Mrs. Sterling, O. N. Stewart, Atherton Thomas, Lyman and Mrs. Tremaine, W. N. and Mrs. Webster, Norman and Mrs. Weiss, U. A. and Mrs. Whitaker, P. S. Wilder, S. L. Williams, William and Mrs. Wolfe and Dr. Dorothy Weeks.

From 6:00 to 7:30 p.m. on Thursday we made merry and renewed old friendships after which we took dinner on our own. Later we had the first installment of the class movies as largely produced by Alan Allen. According to my recollection these













For those who were there, these pictures will bring back memories of Boston and M.I.T. last June; for those who were not there, let them read about the reunion with remorse-and the resolution to do better in 1978. As it turns out (to your Secretary's embarrassment), captions are not possible: he cannot identify everyone. But one picture requires comment: at the top, left, David W. Skinner, our Reunion Gift Chairman, is handing President Jerome B. Wiesner the check for our reunion gift of just over \$8 million. Breene M. Kerr, '51, President of the Alumni Association, shared the special moment as master of ceremonies at the Alumni Day luncheon. (Photos: Sheldon Lowenthal, '73)

covered the last 30 years or so of our five-year reunions. Mary Sterling supplied the commentary. The next morning we sallied forth early via Gray Line busses to the commencement exercises in the Rockwell Cage with Tom Rounds serving as Class Marshall in place of Herb Hayden because of the latter's walking problems. After some two hours I was able to divest myself of the very hot and funny hat. Only one graduate appeared in bare feet! The under garb of many of the graduating class was at least somewhat informal. After this we enjoyed lunch under marquees in the Great Court, had our class pictures taken with and without wives and then journeyed to the dedication of the Tang Residence Hall, formerly Westgate II. As most of you know P. Y. Tang graduated with us with his B.S. degree in business and engineering administration and later in Shanghai and Hong Kong was most successful in textiles. He was a chief contributor to this building and we enjoyed meeting his widow, son and other relatives who attended.

After this we returned to the Marriott for cocktails and class dinner after which Ed Schmitz regaled us with a rendition of "At the Sign of the Three Brass Balls," accompanied by Pete Pennypacker. Ed did three of the old verses plus a new one just composed. After this we did the usual songs including the "Stein Song," "Take me back to Tech" and afterward Pete introduced his latest creation, a new Alma Mater, "To M.I.T." with the aid of a quartet composed of Pete, Chuck Roche, Bill Blandy and Bill Lowry. This song we found to be very melodious and singable although completely new this year. We then saw the remaining class movies, starting with 1922 and proceeding through scenes at the Institute in 1923, the class picnic at Nantasket Beach in June 1923 and several later reunions. Commentary of a thoroughly humorous nature was supplied by Mary Sterling. On Saturday morning most of us left early on the busses to attend sit-down programs at the Green and Whitaker buildings and tours of same.

After a very fine sherry and luncheon at the Student Center we returned to the Marriott in time to change for cocktails and class banquet at the Faculty Club. During dinner we were entertained by Miss Mabel Biagini, an accomplished accordionist. She played many of the old songs which we all joined in on. Pete's new song was tried again with more success in spite of the fact that Miss Biagini had seen the music for the first time that evening. We again did the old M.I.T. songs to good avail after which Ed Schmitz called the class meeting (quinquennial) to order. After the usual secretarial and treasury reports by Tom Rounds, Ray Bond reported on the slate of officers nominated for the ensuing year. Duly elected officers were: Charles M. Mapes, President; Rodney M. Goetchius, Vice President; Thomas E. Rounds, Secretary-Treasurer; James A. Pennypacker, Assistant Secretary. An item of unfinished business is an amendment to the class constitution to permit the election of two additional vice presidents. This will take place subsequently by letter ballot. Also by the same letter ballot voting will take place on Royal Sterling for second vice president and Bertrand A. McKittrick as third vice president whose nominations were accepted at the meeting but whose election could not then be conducted. Herb Hayden thanked his committee for the work done to make the Reunion a success, apologizing for his disability during the critical period

beginning in January.

Ed Schmitz in his parting speech thanked all who had helped make the Reunion a success and called upon Arthur W. Davenport to present a progress report on "The Great History of the Great Class of 1923" of which Dave is entrepreneur, editor and producer. The book is now in the hands of the printer and will contain over 1100 biographies of classmates. He made an appeal for more sales at \$27.50 each. Gavel was passed to Charlie Mapes and meeting adjourned at some time after 10 p.m. On Sunday we had a chance to rest for part of the morning and then, some 110 of us took the Gray Line Tour of historic Cambridge and redeveloped areas of Boston to partake of a (dividend) lunch of Boston scrod on the waterfront at Joseph's Aquarium Restaurant. We then returned to the Marriott for another rest up prior to attending President Wiesner's reception, then buffet dinner at the Student Center and the Pops Concert at Symphony Hall. There is nothing like the Pops and in particular Tech Night there. Monday saw most of us checking out of the Marriott then to the Institute for the Alumni Day program of lectures morning and afternoon interspersed with the Alumni Day Luncheon and finished off with the final reception at the duPont gym. The Alumni Day luncheon certainly featured the generosity of our classmates to M.I.T. With our five-year gift totalling \$8,093,000, and class estate giving coming to \$9,563,000, plus the latest three buildings to which class members have been the major contributors, we certainly seem to be the white-haired boys. At least it is something to be proud of, so we left the reunion with a feeling of pride to be associated with that great institution, a feeling of nostalgia for the old days, a feeling of joy to be able to see our old friends again and a feeling of satisfaction that we could at least in some measure help to make the Institute what it is today.

On Sunday morning on our way to see the old Cambridge and the new Boston we were saddened to learn in one of the Boston papers of the death of our classmate Hugh Perrin who, on his way to our Reunion, passed away in the Logan International Airport. As Class Secretary and Reunion Registrar I had no knowledge that he had intended to come at all but it seemed obvious that he was on his way to take in the Alumni Days events at least. Hugh graduated with us with B.S. in architecture and later got his degree of Master in Architecture. A resident of Dedham for many years, he later moved to Chatham, Mass, and in 1969 retired to Vero Beach, Fla. During World War II he was an operations analyst with the U.S. Army Air Corps and later served as an engineer with the Navy's Division of Special Devices.

We learned somewhat later of the passing of Jack D. Preston of Westport Point, Mass., on April 2, 1973 but have no further details. . . . Finally we were shocked to learn of the passing on June 19, 1973 of Robert L. Hershey of Kennett Township, Pa. After graduation Bob received advanced degrees of Master of Science and Doctor of Science. His distinguished career included teaching and research on the chemical engineering department staff at M.I.T. from 1924 to 1935, the ammonia department's laboratories at duPont Experimental Station of which he became laboratory director in 1939, Assistant Research Director in 1943 and Assistant General Manager of the department in 1948. In 1956 he was promoted to General Manager of the polychemicals department and two years later was elected a vice president, director and executive committee member of the company. Bob accumulated many honors among which were membership in Tau Beta Pi, Alpha Chi Sigma Sigma Xi, American Chemical Society, American Institute of Chemical Engineers and was a fellow of the American Association for the Advancement of Science. This is a very long issue of the 1923 class notes but considering our contributions to Institute life over the years we feel that this is justified even if only for the fact that it is a report of our 50th Reunion .-Thomas E. Rounds, Secretary-Treasurer, 4 Deer Hill Dr., Danbury, Ct., 06810

During a trip to Chatham on Cape Cod, on August 4, your amanuensis turned detective and had lunch at the Governor Carver Motor Inn, Plymouth, Mass. where we will center our 50th Reunion next June. About 35 miles from the Institute, it seems suitable for a clambake, banquet and those not wishing to domicile on campus.

Thanks to Paul Cardinal for sending me a list of our more affluent members who attended the Mexico City Fiesta in March. Of course, Lorene was there along with Austin Cooley and Helene, Andy Kellogg and Bubbles, Ray Lehrer and Dot, Rutilio Torres and Nish Cornish and Luisa. All sing praises of the latter's hospitality and the worthwhile trip to Merida and the ruins of Yucatan.

At 2:00 p.m., September 14 at the Faculty Club, Ed Hanley (50th Gift Chairman) called a meeting of his Committee and Class Officers to discuss steps to be taken to renew the orderly solicitations for the Class Gift, interrupted by the untimely death of Jack Hennessy. This preceded the Alumni Officers Conference, next day.

We regret the loss of Griff Crafts on August 5, 1973 in New York City, as reported in several clippings that I received. Gordon Billard, Bill Correale and Perry Maynard represented our Class at the funeral. I believe that Griff was better known for his non-technical activities than as president of the J. W. Wilson Glass Co., Linden, N.J. He was a professional actor (also Betty, his wife) and a judge of English bulldogs (he had one)

for the American Kennel Club. He was an active churchman, former director of the New York Board of Trade, member of the Players and Chemists Clubs, as well as several Societies and Associations. My most vivid memory of Griff was as the Emcee at our 45th, appearing in a white suit with his mustache immaculately waxed and pointed. We extend our heartfelt condolences to Betty and Anstice.

Alumni Days '73 on June 3 and 4 were attended by Phil Bates and Jocky, Nish Cornish and Luisa, Don Fife, George Glennie, Del Kendall and Erina, Ed Moll and Rene, Nat Schooler, Freda and a grandson, Frank Shaw, Herb Stewart and Winnie, and yours truly with his frau. Not particularly exciting except for the Class of 1923's fantastic gift of some \$9,000,-000 and Professor Edgerton's always anomalous performance. Actually, the weekend's format centered around women's role at M.I.T.

The accomplishments of Austin G. Cooley would remain unknown were it not for his good wife. She sent your scribe a picture of them and an article on Austin clipped from the Fairbanks Daily News-Miner, Alaska. At the May Commencement of the University of Alaska, he received the degree of Professional Engineer, basically a degree between a Master's and a Doctor's, but is not honorary and requires a thesis. His described an automatic photofacsimile recorder which he patented in 1965, and was selected for use by the Associated Press. Austin now resides in Reno, Nev. but has visited Alaska off and on since 1914 and from 1950 to 1969 was a director of his uncle's firm-Lathrop Company. From 1945 until 1970 he held vice presidencies in Times Facsimile Corp. and Litton Systems.

Hugh Perrin died on May 31, 1973 at Boston's Logan airport, reportedly en route to his 50th Class Reunion. He did receive his S.B. in 1923, but Master's in 1924. Hugh was an architect and lived in Dedham, Mass. and Chevy Chase, Md. many years before retiring to Vero Beach, Fla. in 1969. He was A.B. Harvard 1921 and during World War II was an operations analyst with the U.S. Air Corps in the Navy's Division of Special Devices. He had broad interests-inventive gad-

gets, gimmicks and painting.

Ed Moll sends a note from his herb sanctuary in New Hampshire stressing a weight reduction of 26 pounds. First time that I knew that herbs were diuretic. With the note a letter from Marshall Waterman, of Madison, Conn., his summer home, advising of the recent death of William H. Van Dusen in Lugano, Switzerland. Bill was a Course XV man and very active at the Institute, being a member of several Clubs and Societies, and manager of the Golf team in 1923, the first year that it was established as a minor sport by the M.I.T.A.A. He spent a number of years with Dun & Bradstreet, and in 1941 he established a manufacturing business, Van Dusen & Meyer, Inc. The 1967 Alumni Register indicates he had retired. The Class extends its deep sympathy to Eleanor and the family.

Limited space requires your writer to abstract the information suddenly accumulated. Max lifeld sends a very nice

note from Albuquerque, New Mexico, stating that he keeps in touch with Clarke Williams and expects to attend our Fiftieth. . . . Tom Johnson, who has been president of Textron's Welsh Division, Providence, R.I. since 1950, has become the newly created Chairman of of that Division. . . . A letter channeled through Frank Shaw from Howard E. Whitaker, Chilicothe, O., accompanies a check for the 50th Gift and states that, "We really had a good time in Java this winter" doing a job for the International Executive Service Corps. In April, he and Patricia went to California to sell a house and visit a granddaughter. . Hereford writes from Carmel, Calif., that he is gambling quite a lot of time and money on a biography-history book, hopefully marketable. He considers skipping the 50th and donating that expense to the Class Gift. . . . Dick Lassiter is busy keeping his house in repair in Glen Ridge, N.J., and expresses concern for me with a wish for complete recovery. He is doing some consulting work, probably on industrial plant design and construction.

The records show Col. Walter H. Kennett as a recipient of an S.B. in civil engineering and an S.M. in mechanical. However, the army has been his life including active duty in Europe during World War II, after which he was as-signed to Bowdoin College (Maine), receiving an honorary M.A. and retiring in

1953 and now living in Brunswick, Me. The widow of Admiral Felix B. Stump advises us of his death on June 13, 1972, in Bethesda, Md. Awarded an S.M. in aeronautical engineering, in 1924, he was famous for three exploits: as captain of the aircraft carrier Lexington, which was sunk; as head of the task force which defeated the Japanese in Leyte Gulf; and as Commander of the Pacific fleet, retiring in 1958.

Captain (ret.) Robert W. Hart, U.S. Navy, is living in Lynn, Mass. With his background in electrical engineering and electronics, he advanced through the ranks to Chief of Naval Operations Publications with headquarters in the Office of Naval Research, Boston, Mass. . . . Theodore W. (Ted) Kenyon is very busy, not phased by Phase 4, as president of Ken-Lab. Inc., Old Lyme, Conn., making gyroscopes for camera and binocular stabilization. Also computers for the photograph processing industry, other instruments and electro-mechanical devices.

A quote from Al Liff in Beverly Hills, Calif., "Have been retired since January 1967 and enjoying it. Travelled around the world, went on a safari to Africa and returned from Israel and the Caribbean last Christmas. Playing a little golf and lots of bridge." . . . A telethon confirms the retirement in 1971 of E. Curtis (Dean) Plant from Public Service Electric and Gas Co., Newark, N.J. . . . An Alumni Fund envelope completed by Roland N. (Bobus) Black, probably from Richmond, Va., advises, "Heart attack December 1972. Recuperating at a slow but satisfactory pace. Plan trip to Alaska this summer."

It was heartwarming to receive a comforting note from Videt-Yontrakich (Soonchong Punyagupta) now retired in Wash-

ington, D.C. after a lifetime in the service of his country, Thailand. His charming wife, Samponge and two children are esteemed friends of Ethel and me. . . Bill MacCallum and Eleanor, transplanted indefinitely from the briny Pacific at Los Angeles to the smog-free air and water of Cotuit, Mass., remind your Secretary that they are really enjoying their house on the Cape. . . . John Fitch and Mary delayed their usual summer trek from Vero Beach, Fla. to Westport, Mass. because of illness in the family. They expected to arrive before September 14.

I am pleased to acknowledge a communication addressed to "The Class of 1924 M.I.T.," containing a card, "The family of John Francis Hennessy deeply appreciates your sympathy and prayers.'

Paul Cardinal, via an Alumni Fund envelope to Ken Brock and Marty Phillips indicates that he is not always thinking of fun and games. He suggests that Alumni Day be in October, so that parents can visit with progeny on campus and also that Reunion Gifts be announced at the Commencement luncheon. My reaction is that most of the offsprings have looked forward to severing parental guidance, and that the luncheons are attended by the 50th Class only.

Finally, your Secretary wonders if there might be comfort and advantages to members in a mutual exchange of medical problems, such as heart attacks, Parkinsons and strokes. For instance, Eric R. Brater, Cleveland, Oh., mechanical engineering wizard formerly with General Motors, tells me of his experience with pacemakers. There are two new types. One is nuclear and the other, cadium battery powered, but requiring weekly recharge through the skin .- Russell W. Ambach, Secretary, 216 St. Paul St.,

Brookline, Mass. 02146

I was in attendance on Alumni Days and thoroughly enjoyed the company of Chink and Mrs. Drew, Doc and Mrs. Foster, Jim Howard, Ed and Mrs. Kussmaul, Sam and Mrs. Spiker, Karl and Mrs. Van Tassel, Ed McLaughlin, and Masaru Kemetani. Kami was accompanied by a friend who was interested in educational possibilities in America. I wish you could see the detailed itinerary that Kami sent me giving exact times of his entire trip showing arrivals and departures from coast to coast. I have been promised more about the honors showered upon Doc Foster on his retirement from the Lowell Institute. Doc has promised to furnish details but I hint that he was not only represented in the lobby of Kresge in person but by a stunning portrait.

Henry Sacks sent his annual report which goes into much detail of continued travels both at home and abroad. He is looking forward to the 50th. Mary W. Tripp attended the National Convention of the Society of Women Engineers at M.I.T. in June of 1972. . . . Dr. Thomas J. Killian has been Visiting Professor of Applied Science at Portland State University and expects to continue through 1973-1974. . . Anthony G. Tsongas has retired to Lewiston, N.Y., on the banks of the Niagara River. He had spent 43 years in the service of the City of New York and for the last 20 years he was Chief of Electrical Design in the Public Works Department. . . . Harold Bishko survived the flood in Elmira, N.Y. When his house is repaired he hopes to dispose of it and move to California. He expects to be with us for the 50th.

My wife and I returned from our Alaskan trip and while there it was interesting to hear little news of the "Lower 48" except that which concerned the Pipeline. If they had heard of the Yukon and Mckenzie River plans it was being kept a deep dark secret. We had the experience of an earthquake (very slight) in Fairbanks and two gorgeous views of Mt. McKinley, one from the plane, the other from the railroad enroute to McKinley Park.

Meyer Shacat has been retired from the M. and T. Subsidiary of the American Can Co., since 1966. Beside traveling he spends time between homes in Waterbury, Conn., and Miami Beach, Fla. . . Virgil F. Halliburton on retirement in 1965 designed and built a house in Nevada which is a town about 100 miles south of Kansas City, Mo. G. Colburn Myrick established the Myrick and Chevalier Construction Engineers in 1958. This firm provides planning and architectural services to manufacturers and land developers. He has been married 47 years to Charlotte Babson of Melrose, Mass., and has two sons. . . . Charles L. Norton, Jr., of Augusta, Ga., a retired executive of Babcock and Wilcox Co., was granted the A.S.T.M. Award of Merit and named a Fellow of the American Society for Testing and Materials on October 4. He was a research assistant and instructor at M.I.T., before joing B. and W. in 1930. . Gates W. Barrows of Santa Ana. Calif., was elected to the College of Fellows of the American Institute of Architects. The installation was made at the Convention in May 1973.

I am sorry to have to report the passing of the following class members: J. Marshall Osborne of Torrance, Calif., on April 7, 1972; C. Minot Fogg of Westfield, N.J. on January 15, 1970; William C. Noell of Alexandria, Va., on September 28, 1970; Hoyt S. Griffith of Saunderstown, R.I. on November 6, 1971, G. Sumner Teel of Epping, N.H., on May 6, 1972 and Roger Griswold of Trenton, Maine, on June 9, 1973. Roger was a native of Cambridge and at the time of his death was wintering in California. As a child he spent his summers at Seal Cove, Maine. He attended Milton Academy and Harvard before receiving his architectural degree from M.I.T. During World War II he was a lieutenant colonel in the Air Corps. He is survived by this widow, Cristene de M. Goutier and by a son and three daughters, children of an earlier marriage.-E. Willard Gardiner (Will), Secretary, 53 Foster St., Cambridge, Mass. 02138

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Fortunately it's raining in Pigeon Cove this mid-August morning—otherwise these Notes would be late. On Friday we take the "Bullseye" to Buzzards Bay to



When F. Leroy Foster, '25, retired this spring after 14 years as Director of the Lowell Institute School, alumni, faculty and friends of the School commissioned this portrait by Robert D. Hunter. It was unveiled by Frank Montisano (right),

President-Elect of the School's Alumni Association, at the annual dinner—with Bruce D. Wedlock, '56, the School's new Director, and the subject proudly looking on. (Photo: Susan Pogany)

race in the Nationals over the weekend. There is always something more that must be done on a boat and even though she's hauled out and resting on her trailer, there still are fittings to be added or moved. On a Sunday in July we had sailed into Pigeon Cove harbor for a quick bite between races and Benny Margolin was walking along the pier. (He had been over to pick up some lobster.) In the very few minutes we had to talk, Ben told of the death of Martin Bergen. A clipping sent-by Howard Humphrey from Wilmington, Delaware Morning News gives more detail. Martin was 71 and had been living in Newark, Del. After 15 years with the duPont Co., Martin went into teaching and had been Dean of Pratt Evening School and head of the Mechanical Technology Department of Staten Island College. We are still receiving letters from classmates and friends telling of the passing of Frank Schreiner. Dan Metzger, '27, wrote us a nice letter in which he mentioned that Frank's big activity while at M.I.T. was the musical clubs when he was the Glee Club leader. Those of you who attended our 45th Reunion will recall that Frank lead the singing and he did it with the flair of a real pro. Bill Sessions also sent us the clipping about Frank's death and wrote us a nice letter about his contacts with Frank. Bill's letterhead indicates that he is still the active patent attorney in Cleveland but he does indicate that he plans to reduce his pace and that he will be at our 50th.

About a month ago George Breck phoned—said he was in Rockport. While his wife shopped George came over and we had coffee on the terrace. George now divides his time between a home in Plymouth and one in Florida. He has two principal, activities—one a family homestead and museum in Middleboro, Mass., with furnishings and displays dating back to the 1600's. He and Ben Richardson have gotten together on the genealogies. The other Breck activity is presenting the

pros and cons of smoking to young people. George has produced a bulletin beamed at the reasoning of youth and has distributed over 100 thousand already. . . . Tony Gabrenas has been in the area all summer-first a card from Hardwick announced his presence then a phone call from Billerica gave us a nice opportunity to chat. Tony likes to retreat from Miami heat in the summer and New England appears to suit his needs. . . . Pete Doelger has been moving around this summer. First he came north to the late June wedding of his son Peter in Greenwich, Conn., and duly reported in the New York Times. Then a phone call let us know that he was in the area, followed with a postcard from the White Mountains and another card a couple of days ago from Aspen, Colo.

Now we must admit having run away from Class Notes for a couple of hours to pay a visit to the sailmaker who has installed a new "wrinkle" on our sail known as "jiffy-reefing." It always blows at Buzzards Bay and often enough to make reefing necessary so we could not head out unprepared. Returning to our task, the top article is a six-page clipping from Sports Illustrated of May 28 about classmate Dick Pough's ecological achievements, to quote: "It may well be that Richard H. Pough is the most effective and least publicized conservationist in the U.S." Dick as you know has been a naturalist since (and before) his M.I.T. days so his ground work for today's problems and programs is unique. His primary occupation today is President of the Natural Area Council, an umbrella conservation organization funded by contributions from foundations. Dick has always lived an enjoyable life doing what he preferred with no transition from school to work to retirement because all of his efforts have been and are in the same area.

One more classmate left us this summer. Cecil Ogren died in Ipswich, Mass., in mid June at age 72. Cecil had been in

military work since graduation and when retired two years ago he was the chief civilian of the U.S. Missile System Division at Bedford, Mass. He dropped by to see us at Pigeon Cove at about the time of his retirement. To the families of these classmates who have left us this summer we extend the sympathy of the Class of '26.

We have a nice letter from Dwight Woods and another from Stew Perry but will have to tell you about their activities plus those of several other classmates in the next issue (after the sailing season is over.) So until then-Cheerio and a Happy Thanksgiving!—George Warren Smith, Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

I have a nice long newsy letter from Les Woolfendon's wife, who says that Les is too modest to realize that his classmates are interested in what he is doing. It would be pleasant if a few other 1927 wives were to follow her example.

Ethel writes that Les continues to keep extremely busy in retirement with a consulting job for G.A.F. and membership on the building boards of the Paducah, Kentucky bank and the new Lourdes Hospital. He was, until recently, on various Chamber of Commerce Committees until Ethel suggested he was overdoing it, but he still attends Rotary. His leisure activities, which he and Ethel share, include caring for a two-acre garden, stamp collecting, and bird watching. They have had over 60 varieties at their bird feeders this past year, and recently spotted 10 white pelicans on the Ohio River-extremely rare in that area. Their older son, Glen, is a professor at the University of Southern Florida and in 1974 will be going to a convention in Canberra, Australia, where he will visit his younger brother, Don, who is currently living there and working on a geological survey. Ethel and Les celebrated their 45th wedding anniversary last January, attended their 50th High School Reunion this year, and are looking foreard to our 50th in 1977.

Speaking of the 50th, Bud Fisher has agreed to serve again as reunion gift chairman and has been busy over the summer organizing his committee. You will be hearing from them from time to time, but it's worth reminding you here that every 1927 gift to M.I.T. from June, 1972, through June, 1977, counts as part of the 50th Reunion Gift. Bud's goal is \$500,000, with as close as possible to 100 per cent participation. He worked tirelessly, on the successful 40th Reunion Gift Drive, and we owe him a debt of gratitude for his willingness to undertake the job again.

The mini-reunion on Alumni Day last June drew a baker's dozen of the 1927 Class, mostly from the Boston area. Perhaps if the mini-reunions become a fixture, more of us will make the effort to get there. Those attending were Dike Arnold, James F. Collins, Harold Edgerton, Bud Fisher, Dick Hawkins, Ray Hibbert, Morris Leonard, Jim Lyles, Ezra Stevens, and Bill Taggart-all with their

wives-plus Joe Burley and Art Connell. In the Notes last May, I commented that Dick Donald had been a neighbor of mine, and a fellow member of the Scarsdale Town Club, for many years, and I did not know it until word came of his death. Since then, I have had a phone call from Jack Peters, who has also been living in Scarsdale and has been a member of the Town Club for many years, but even in a community as small as this (5000 families) we have never run into each other. Jack went on from M.I.T. to the Harvard Business School and has spent most of his career in advertising; he is currently with a House Agency here in Westchester.

The Alumni Gift envelopes bring a welcome grist of news. Prentiss Cole writes: "I sold my firm, Cole Rubber and Plastics, Inc., and retired in August, 1972. If any of my classmates want to find out what all play and no work does for one's golf, look me up on your next trip to Palo Alto." Speaking of golf, those who have been at our recent reunions know that Louis "Pete" Peterson usually walks off with the golf prize. Since retirement in 1970 as Manager of Purchases of Newport News and Dry Dock, Pete has been taking part in many senior tournaments. He and Dena are in excellent health. They have been spending their winters in Vero Beach and expect to move there permanently this fall. . . . Percy Richardson writes that J. B. Snediker had an apartment in the same condominium where Percy lives (in Venice, Fla.) last winter. . . . Carl Rudd has retired recently as chief engineer of the Baltimore consulting engineering firm of Van Rensselaer, Saxe. He tells us he has been in touch with several of our classmates, including Alan Beattle-retired and living with his wife, Louise, in Chester, Conn.; Colonel Paul Ivancich, U.S.A. retired, in Washington, D.C.; and Henry "Shorty" Newell, who has retired to Frederick, Md., after a career with Turner Construction.

Lauritz Rasmussen is devoting a lot of his leisure to art, opera, ballet, symphony, and theatre (all presumably as a spectator), and to travel and political action. He writes, "I visited Vernon and Alice Mac-Kenzie (my sister) at their beautiful home on Sanibel Island, Fla. Vernon retired in 1969 from the U.S. Public Health Service as Rear Admiral, Senior Grade, but is still very active in public health matters."

Two of our classmates have been active on the lecture circuit. We have previously reported on John Parker's "Haunted House" lectures; he is now lecturing also on the history of New England architecture, illustrating the lectures with his own paintings. Charles Carr's subject is quite different; he is a Christian Science lecturer and teacher, and he talks on how spiritual understanding of man's basic nature can heal the individual and help to solve community problems. . . . Parke Hodges has retired as President and Treasurer of Behre Dolbear and Co., mining, geological, and metallurgical consultants, but will continue as a parttime consultant. . . Russ Westerhoff, retired chairman of Ford, Bacon and Davis, will be Reception Committee Chairman at the July, 1974, meeting at Atlantic City of the National Society of Professional Engineers, which will feature the 50th anniversary of the New Jersey Chapter.

There are five more deaths to report, and the sympathy of the Class goes out to the family of each. Colonel Wallace Hastings died in 1967 after a career with the Corps of Engineers and the Rand Corp. . . . Henry "Ted" Lyons died in Allentown, Penn., in October, 1971. He had been a partner in Lehigh Engineering Co. . . . Malcolm Graham died last January in Norwalk, Conn.; before his retirement in 1967, he was a senior engineer with Pitney-Bowes. . . . In April, 1973, Edward G. Burgess of Brookfield Center, Conn., passed away; he had spent most of his working career on military instrumentation, with such firms as Ford Instrument and Sperry Gyroscope. . . And in June, Dr. James K. Small died. He had retired in 1967, and had previously been in the Patents and Licenses Division of Esso Research. He had a Doctor of Jurisprudence degree from N.Y.U.

On a happier note, I have received an announcement that Horace Emerson, who was widowed more than two years ago, was married on July 14, 1973, to Shirley Sacco, in Westerly, R.I.

The alumni office reports the following address changes, some of which may be seasonal: Francis T. Cahill, from Revere to Eastham, Mass.; Andrew Canzonelli, from Arlington, Mass., to Buzzards Bay; Louis F. Eaton, from Duxbury, Mass., to Centre Harbor, N.H.; James B. Snediker, from HoHoKus, N.J., to Lockport, N.Y.; and Otman Praznick, from Hallandale, Fla., to Quincy, Mass.-Joseph H. Melhado, Secretary, 24 Rodney Rd., Scarsdale, N.Y. 10583

Our 45-year Reunion at Bald Peak Colony Club was an unqualified success. We had wonderful attendance, beautiful weather, a magnificent meeting place, excellent service and a weekend of enjoyment and fun that passed all too quickly. Chairman Dick Rubin and his entire committee are to be commended for doing an outstanding job. Some indication of the enthusiasm level is that nearly everyone had checked in by Friday evening for a total attendance of 158-86 men and 72 girls. The housing problem was solved by doubling up the single attendees and by engaging a nearby motel to handle the overflow. There may have been some inconveniences but no complaint was heard. The difficult task of managing reservations and accommodations was handled effectively by Carl Feldman to whom we express our thanks and appreciation.

On Friday evening the Ralph T. Jope Cocktail Party brought everyone together for the first scheduled event. It was pure pleasure just to see and hear such a happy gathering. After dinner movies were shown of all earlier Reunions going back to the first one when we were only five years old as a Class. Several of our travelers brought along slides and showed us the places and sights they





H. W. Fisher, Chairman, 1927's 50th Reunion Gift Committee

C. B. Allen, Class of 1929

had visited. In addition there were a number of other movies and related talks. Most of us went on the two-hour cruise of Lake Winnipesaukee aboard the M. V. Doris E. Saturday morning. The boat was brought right up to the club dock where it was easy for us to board and then later to disembark. At times it was a bit windy and choppy on the lake but nobody seemed to mind, even those who got sprayed once or twice. The cruise like everything else on the program, went off perfectly and on schedule thanks largely to Carney Goldberg who attended to all activity details. Many took advantage of the good weather to golf, play tennis or to bowl on the green. Others did some local exploring or shopping. One of the points of interest, Castle in the Clouds (built early in the century by a retired New England shoe manufacturer), was especially a favorite.

At the noon lunch on Saturday Tom Larson officiated in the awarding of prizes of all levels of achievement in the various golf, tennis and bowling tournaments. Following this our good class president, Jim Donovan, rose to say that he had not planned to give a speech but then immediately launched into one. By the time he finished he had given a full report on the Class and had conducted a whirlwind election of unprecedented type and scope. All existing officials and other working members of the Class were made vice presidents. Then the same honor was extended to all those who had regularly supported the Class and finally to all those who might be expected to support the Class. . . . Florence Jope, our honorary classmate (always closely involved and hard at work in class activities), was made honorary president. With a Class consisting entirely of officers, it is Jim's expectation that there will be a 100 per cent participation in and support of class objectives from here on.

Saturday evening was the high point of the Reunion. It began with the Bill Carlisle Cocktail Hour. Then followed dinner, dancing, and for those so inclined, some additional hobby talks. Later a song fest got started with George Mangurian and Bud Wilbur alternating at the piano while occasional assistance (?) was given by Morey Klegerman, Abe Woolf and Walt Smith on fiddles that were in tune most of the time. Sunday morning was parting time for most after what many declared the best '28 Reunion ever. As a gift memento each of the girls took home an attractive red, white and gray tote bag of modernistic design. Each classmate had a handsome glass bottom pewter tankard that was beautifully and appropriately engraved. Gladys and Dave Olken were responsible for the gift function and they certainly pleased everyone. More than a few asked why should we have to wait five years for another such gathering and suggested an Interim or Mini Reunion to be held perhaps in two years.

Of the group at Bald Peak, 42 drove to Cambridge to attend Alumni Day activities at the Institute beginning with the buffet dinner and then the concert at Symphony Hall where Arthur Fiedler and the Boston Pops Orchestra gave a memorable performance to a highly enthusiastic house packed with M.I.T. classes.

Finally, and relative to the Reunion, we would like to have prints from those who were so busy taking pictures. There were also several movie cameras at work and we would like to arrange for copies of successful shots or whole reels if possible.

We have accumulated a number of letters some of which we will have to report upon in our next issue of Notes. Mary and Max Parshall wrote that they had made it back to Hamilton, Montana but with a case of pneumonia for Max and a bad cold for Mary. A later letter assured us of good recoveries for both. . . . El Atwood wrote to say how sorry he and Beryl were to have missed the 45th. Beryl had been scheduled for surgery in the middle of May but delays carried the date to June 4. At the time of his letter (July 9) El reported that Beryl was home with nurses three times a day. He expected that she would be back to something like normal by summer's end. . . . Jo and Fritz Rutherford expressed appreciation for all the effort that had gone into preparation of the weekend party they enjoyed so much and urged that the idea of a Mini Reunion be implemented. They favor Mexico City during Fiesta season. . . . Tom Harvey also regretted having to miss the 45th but he is planning to be at the 50th. Tom and his wife Gracia recently returned from an Aegean holiday trip to Turkey and Greece. They enjoyed seeing the famous Blue Mosque, the Topkapi Palace (now a museum) and the site of ancient Troy. In Athens they were much impressed by the Acropolis and the ruins of the Parthenon .- Walter J. Smith, Secretary, 209 Waverly St., Arlington, Mass. 02174

The Twenty-Niners attended Alumni Day activities last June: William Baumrucker, Ruth Dean, Karnig S. Dinjian and wife, Jerry Gardner and wife, Wally Gale and wife, Eleanor Horwitz, Mal Hubbard and wife, Virgil McDaniel and wife, Frank Mead and wife, Joseph Speyer and wife and David Wilson and wife.

I regret to announce the deaths of three members of our Class: Austin Fribance of Romulus, N.Y., on May 11; C. Brigham Allen, Jr., Orlando, Fla., on May 19 and Frank O. Pierson of Cromwell, Conn., on July 2. After receiving his B.S. and M.S. degrees from M.I.T. Mr. Fribance taught at Westerly High School from 1935 to 1938. He was a major in World War II and a former consultant to the U.S. Department of Health Education and Welfare. He was also a consultant to the Instrumentation Society of America. He was a teacher at Rochester Institute of Technology where he taught electrical engineering and industrial instrumentation. He is survived by his wife Winifred, two sons, Austin A., John A., of Rochester and two daughters, Mrs. Thomas Wickes and Caroline Fribance.

C. Brigham Allen, Jr., affectionately known as Brig, was the first president of our Class since the Junior year. While an undergraduate, he participated in a long list of activities, both athletic and academic, and was a member of as many clubs and organizations. Upon graduation, he went to work for Reliance Electric and Engineering Co. In his biographical sketch, he says, ". . . except for a few years in the late '30s, I have been with Reliance. During World War II, the company loaned me to the U.S. Navy to work for the Bureau of Ships where I worked with Admiral Rickover, then a fleet commander. While working for Reliance, I moved around the Eastern part of the U.S." He was District Manager of the company in Detroit when he retired in 1968. Shortly after our 40th Reunion, where Brig and Evelyn attended, they moved to Orlando, Fla. I received a note from Evelyn announcing Brig's death which says in part, "Brig was doing so well for the past several months, so that his sudden death was a shock to me and to his friends. We have been living here in Orlando for four years and I sup-pose I'll stay here for awhile anyway." Besides his wife Evelyn, he is survived by his father, Carlton B. Allen '02, of New York, who attended his 70th Class Reunion at the age of 92. Brig was so proud of his father's record. Evelyn's address is 2412 Caribbean Court, Orlando, Fla. 32805.

Frank O. Pierson of Cromwell, Conn., had recently retired from a family-owned nursery business, A. N. Pierson where he was Executive Vice President. Professionally, he was an Industrial Engineer and worked for DuPont Chemical Co., in Tennessee; International Paper Co., New York; Chief Engineer at the Atlantic-Richfield and Vice President of Q-Tip Co., of Long Island. He and his wife Florence attended our 40th Reunion. Ironically, Frank was the first one to send me a note dated June 11 stating enthusiastically that they plan to attend our forthcoming Reunion at Chatham Bars Inn. He was optimistic towards his retirement years and having purchased a 30-foot trailer they planned to travel all over the country, stopping at such places where golfing and water sports are available.

Ira H. Abbott Moultonboro, N.H., writes, "Now that I have retired completely, not even consulting work, there still is not nearly enough time to do all that I would like to do, such as reading, doing chores and in season, fly fishing, hunting, golf, and wood working." . . . Michael J. Com-

perchio of Hyde Park, Mass., writes, "Preparing for my retirement in June, 1974, which will give me 33 years of service to the Federal Government. Currently, I am Chief of the Production Engineering Branch of the Defense Contract Administration Services Region in Boston. In addition to Pre-Award Surveys of prospective contractor's capability, the engineering staff is also responsible for technical evaluation of proposals submitted by contractors. I have been doing this since 1965. Prior to that I was Assistant Chief of the Inspection Division of the Boston Procurement District until it was consolidated with the above."

A flattering note comes from Gordon Carr of New York, "I want to thank you for that surprising birthday greeting from Class of 1929. When I think of what a job it is to remember birthdays-and you have a family. I enjoy reading the Class Notes, every issue as well as other items; and I sure take off my hat to you for the hard work you are doing and the pleasure you give to so many. . . . C. Wingate Reed retired Colonel, U.S. Army writes, "Thanks for the card. Though I was only a graduate student in the Army Ordinance School, I do appreciate being included in the Class of '29." . . . Bill Aldrich, Billings, Montana. "The birthday card idea has been wonderful and I enjoy reading the Class Notes. Most of our classmates seem to be retiring or have retired. Not many have been dropping by here for sometime. Time to think of our next renuion and I hope to make it. Things are generally the same, only more to do and less time to do them. Best regards to all."

Alfred N. Lawrence, Lawrence, N.Y. writes, "I have never been as busy as I am now since retirement. There seems to be many things around the house which need fixing. Thanks for remembering my birthday, which happened to be my 70th."

. Jonathan F. McCray, Heber Springs, Ark., writes, "I have been retired for nearly five years, so I am well adjusted to it. I served as County Chairman for the Cancer Crusade in 1972 and we were fortunate enough to surpass previous campaign contributions. At present, I am County Chairman of the Republican County Committee in an effort to achieve a viable two-party system in the country."

Edwin H. Perkins, Ipswich, Mass., writes, "I retired two years ago from Bell Telephone Lab., after 40 years of service. We converted our summer home in Ipswich into an all-year-round house, so we are living at the shore. This year, I am Commander of Merrimac River Power Squadron, U.S.P.S. My wife and I use our motor home for trips in spring and fall, and I sail a 26-foot sloop in the summer. In the winter, I read a lot and attend Masonic meetings. In short, I am doing all the things there was no time for while I was working."

Romer H. Guest, Greensboro, N.C., is sending greetings to all his classmates and waiting for our 45th Reunion. . . . Helen May Walther, Blairstown, N.J. "I have spent most of last year fighting a proposed super-highway that would destroy our rural countryside." . . . Milton Male, Pittsburgh, Pa., writes, "Since retirement three years ago, we have done

lots of traveling, reading and golfing. So far we are blessed with good health so things are fine with us. With children in Connecticut and Florida, we have plenty of excuse for traveling (if any were needed) and we have taken a number of cruises in the last few years as well. Hope to make the 45th Reunion."

V. W. "Dan" McDaniel, Guilford, Conn., writes, "Retired after 33 years of service with the Inmont, Corp., at the end of May, 1973. Currently, I am catching up on deferred work at home and helping a young engineer start his Environmental Source Control Service for industry. Betty and I enjoyed the fine program at M.I.T. celebrating the Centennial of the first woman graduate and seeing the '29 classmates at Pops and Class Day."

James C. Coe of Phoenix, Ariz., writes, "Have taken mineralogy and Lapidary as a hobby and have published a number of articles in various magazines on the subject." . . . Peter Gnoocheff, Los Angeles, Calif., writes, "I still live in the same old house in L.A., and working for Carl Maston, Architect as I have done for past 20 years. I lost my wife five years ago. She died from an incurable disease, and I am still half living. I plan to retire in the near future in South Laguna where my sister and my daughter live." . . . Remember our 45th Reunion-Chatham Bars Inn (the Cape) May 30 to June 2.-Karnig S. Dinjian, Secretary, 6 Plaice Cove, Hampton, N.H. 03842

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Once again the flaps on the Alumni fund envelopes have "saved the day" for your Secretary; nearly all of the following items are derived therefrom. . . . Lester Meyer writes that he is grateful for being mentioned in the May 1973 Notes, but that the statement that he works for the State of Illinois leaves something to be desired in the matter of accuracy. It seems that while the firm of Sheppard, Morgan and Schwab (Civil Engineers and Survevors) with whom he is associated does some work for the State of Illinois, they also do work for other clients as well. He feels that the firm, as well as the other clients, "deserve some credit for keeping me employed these 29 years, plus." Just another example of the risk involved in relying on "hearsay" evidence, Lester. . . . Eleanor and Morell (Hijo) Marean have sold their real estate business in Marblehead, Mass., and bought a condominium in Florida at an address which was unfortunately detached from the slip I received. They visited Jack Bennett and his wife on Captiva Island while house hunting in Florida last winter. . . . Ed Baldwin is starting a new general consulting business, Northport Associates, in Northport, Maine, where the Baldwins live in a house over-looking Penobscot Bay. He says it is a pleasant change from the flatness of the Mid-West.

Ed Giroux and his wife are still dividing their time between Pompano, Fla., and West Baldwin, Maine. They have joined art associations in both states and have their own art gallery in Maine. . . . Ted Bridge retired from Catalytic Inc., as of the beginning of 1973 and moved to

Springfield, Mass. He plans to swim a lot in the summer and play with his new D.E.C.-PDP8 mini-computer in the winter. . . . Isabelle and Horace Myers have just completed the building of a new home on Lake Joyce about 25 miles north of Tampa. He reports that they are both in good health and enjoying semi-retirement. . . . Charley Dwight has retired as Vice President and Treasurer of the University of Hartford. He joined the administrative staff of University of Hartford in 1962 after 30 years with the Hartford Electric Light Co. He is a trustee of the State-Dime Savings Bank and a past director and chairman of the budget committee of the Greater Hartford Chamber of Commerce. . . . As previously reported, Hank Luykx retired in the mid-'60s as Chief of the Biometrics Division of the Surgeon General's Office. He and his wife live in St. Michaels, Md. He lists his hoppies as sailing, travelling and enjoy-

Changes of address: Dr. Adloph C. Hugin, 7602 Boulder St., Springfield, Va. 22151; C. Thurston Ramsey, 1483 Westgate Dr. #3, Kissimmee, Fla. 32741; King Tow, 3829 Radcliff Lane, San Diego, Cal. 92122; Charles W. Twelves, Jr., 2135 Ascat Dr. #10, Moraga, Cal. 94556; Elroy Webber, Box 163 Church St., New Hartford, Conn. 06057—Gordon K. Lister, Secretary, 530 Fifth Ave., New York, N.Y.

A note from Bill Stellrecht tells of his marriage on June 1 to Renate Altvater-Anton. Congratulations and all good wishes, Bill. Although he didn't give me any information concerning himself, Nelson Haskell very thoughtfully sent me a clipping from the May 14 issue of an Oil and Gas journal telling of Norman FitzGerald's activities as an independent oil operator. Norm is in his second term as President of the West Central Texas Oil and Gas Association and is widely considered one of the best thinkers and most erudite spokesmen for independent oilmen in his area. Twenty-eight years ago, after working for the Petroleum Administrative Board, Bureau of Mines, Chase Manhattan Bank and Great Lakes Carbon Co., Norm started out as an independent in Abilene and seems to have enjoyed every minute of it. . . . Colonel Howard Bogert writes that he is now settled in a retirement community in Santa Barbara where his main physical activities are swimming and walking. . . . Howard Pyle tells me that several issues back in Technology Review he was listed as in the Class of '32, whereas "Doc" Vincent was listed as '31. Since they both took the same train to Tech and left at the same time, Howard wants to make sure he is put in his correct class, '31. . . . A Belknap College release reports that C. Sterling Wyckoff, Jr., now has professor emeritus status. . . . Congratulations to Frederic Jelen on his Guest Speaker's Bureau Award from the American Association of Cost Engineers. An article in the Chelsea, Mass. Record reports that John Cohen, a meteorologist with the National Weather Service, has begun a

one-year tour of duty with the weather service on Swan Island at the edge of the "hurricane belt" in the Caribbean.

John Parker writes that he is spending one more year as Chairman, Department of City Regional Planning at the University of North Carolina. His son, John, is Professor of Medicine at the Medical school in Chapel Hill and the other son, Bob, is Head of the English Department at Groton School. He and Jane, who retired last year from U.N.C.'s faculty, are looking forward to seeing Europe in 1974-5. John didn't mention whether or not he plans to take his four grandchildren along. We were sorry to hear from Leslie Reed that his wife, Margaret, passed away November 27, 1972. Les is still active in contracting and now has four delightful grandchildren. . . . Louis Evans reports that he has just returned from an exciting two month round-the-world trip, one month touring through the Orient and one month on business in Japan. The tour took Lou and his wife to Iran, Kashmir, Nepal, Singapore, Bali and Hong Kong. While in Japan, Lou conducted a fourweek training session in refining technology for Mobil associated technical personnel. He is retiring November 1 and looking forward to more travel. . Herbert Raymond, whose address is 101 Old Mamaroneck Rd., White Plains, N.Y. says he is enjoying semi-retirement as the Financial Manager of a small mailing list business. A news release tells of John Lawson's election to a three-year term on the Board of Directors of the National Council of Teachers of Mathematics.

An article in the Piscataguis Observer (Dover-Foxcroft, Maine) reports that Ralph Hartline has retired as manager of a refinery on the island of Borneo. Ralph is interested in Oriental art work, handcarved sculptures and Chinese designed pottery and has brought back a fine collection. . . Victor Duplin, Jr., retired from Babcock and Wilcox Nuclear Facility and he and his wife are now raising Angus cattle. . . Among those from our Class who attended Alumni Day were Janet and Larry Barnard, Helen and Ralph Davis, Olive and Harold Gurney, Jean and Claude Machen, Ted Morrill and his wife, Arnold Nylander and his wife, Alice and Al Pierce, Bryce Prindle and his wife, Howard Richardson, Don Sinclair, John Slavin and his wife and last but not least, Margaret and Al Ziegler. While in Tokyo recently, Sally and I had dinner with John Minami and his wife. We also spent considerable time with one of Sally's Wellesley friends and her husband, Fuki and Sami Uramatsu, who showed Sally around Tokyo while I had my nose to the grindstone. Word has just been received of James J. Mazzoni's death on March 30, 1973. Our deepest sympathy to his widow.

We received late word of Gordon D. Shellard's death on July 13, 1973, after a long illness. At the time of his death, he was an associate actuary with the New York Life Insurance Co. He was a Fellow of the Society of Actuaries, a charter member and Fellow of the Operations Research Society of America after pioneering work in that field in antisubmarine warfare during World War II, and a member of the American Statistical

Association. He was an active member of the Appalachian Mountain Club and an elder of the West Side Presbyterian Church. Mr. Shellard is survived by his wife, Dorothy and by his son Robert.—Edwin S. Worden, Secretary 35 Minute Man Hill, Westport, Conn. 06880

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Retirees are making news during these passing months and years. Russell S. Robinson is settling into the leisure life on his new property in Tucson, Ariz., hoping to explore the surrounding desert and mountain areas, between visits from friends and relatives passing through town. . . . John J. Such left the Kendall Co., in June 1972 after 33 years of a most satisfying career and found the pace of retirement apparently too hectic since a sudden heart attack at the year-end put him in the hospital but at the last report he states a slight slow down "but not too much." . . . Raymond K. Flege, Georgia Tech Professor Emeritus, retired in June 1972, recently completed a threemonth assignment in Iran for the International Executive Service Corps. He served as an advisor to the Teheran Polytechnic School in Teheran. . . . Philip S. Benjamin keeps busy after three years of retirement with travel and his hobbies of making wood furniture for Montesori schools and part-time as a craftsman at the Old Sturbridge Village in Sturbridge, Mass. ... Philip T. Boothby retired in June 1973 after 34 years with the Public Works Department at the Portsmouth Naval Shipyard and relates he is moving to North Conway, N.H., to devote his attention "to organ playing, pool playing, skiing, sailing and traveling." . . . Richard W. Berry, after 40 years in the steamship business, retired last year from the United Fruit Co., now United Brands, and remains active and available for consulting work on total transportation and distribution systems.

Carroll L. Wilson, a professor in the Sloan School of Management, has proposed in the lead article in the July 25th issue of "Tech Talk" a plan that would meet the national energy emergency by 1985 through heavy use of coal, the construction of underground nuclear power plants and a reduction in the growth rate of energy consumption. Carroll served as General Manager of the Atomic Energy Commission from 1947 to 1951.

Herbert Uhlig has been elected President of the Thoreau Society for the period 1973-74. Charles B. McCoy participated in the dedication program for the new Chemistry Building at Purdue University with a talk entitled, "Chemistry in the Service of Mankind." Your Secretary has received a note from Alma G. Gasio, Executive Secretary, M.I.T. Club of Mexico City, expressing appreciation for the attendance of the following class members at the 25th Anniversary meeting of the Club: Phyllis and Donald Brookfield, Jewel and Frank Chaplin, and Frederick C. Alexander. Among those present at the Mini-Reunion Alumni Day activities were John J. Brown and his wife, Albert and Mrs. Dietz, John and Mrs. Flatley, Donald and Mrs. Miller, Charles H. Taylor, Harold Tonsing, Donald and Mrs. Whiston, and G. Edward Nealand.

With regret we must report the deaths of the following classmates: David C. Lionberger, April 22, 1970; Edward C. Pfeffer, Jr., January 13, 1972; Henry J. D. Meyer, March 4, 1972; Julius Brody, October 22, 1972; Theodore R. Freeman, January 5, 1973; Miguel A. Sastre, March 5, 1973. Our deepest sympathy to their families.—John W. Flatley, Secretary, 6652-32nd St., N.W., Washington, D. C. 20015

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I expect that this to me will seem anticlimactic after the interim letter, and rightfully so as most of this will be press and Fund capsules, with a few address changes. The top one is from Charlie Cashman, who allows that he has retired as a chemical engineer, and is practicing law in Fitchburg. He is a member of the Massachusetts Federal and Supreme Court bars. This remarkable story has appeared here before, so you will recall that Charlie got himself into the Law long after he took his degree from M.I.T. . . . From Leon Hyzen comes a plaintive note; 'would like to know about John Sweeney, Course IV, 33! Have you heard from him?" Sorry, Leon, please join the club. No one, but no one hears from John Sweeney. I saw him at dinner in St. Louis 4-5 years ago, and that's all. . . . John Rumsey, who attended the 40th, writes that he is still in the material handling work as formerly, for hospitals, factories, etc., but does not mention his company, which is located in Detroit. John says he keeps healthy through tennis, sailing, skiing, and swimming.

Bob Dobson comes through with some interesting news; he is Chairman of the Board of Doane Liberal Arts College; the eldest of such in Nebraska. Doane is a basic Congregational School. Now retired from Warner-Lambert Co., is Bob Heggie, who writes of his leisure. He was Vice President in charge of Technical Development and Control, fall of '71. Bob took himself a long trip to the Pacific and stopped at Hawaii, New Zealand, Australia, Bali, Thailand, Singapore, Hong Kong, and Japan. (I followed him two years later, same cruise, I guess). He spent six weeks in South Korea, representing the International Executive Service Corps (more detail in earlier news), then Fall of 1972, visited Turkey, Syria, Lebanon, Israel, Egypt, Cyprus, Greece, Italy and England. For a pleasant change we have a rather nice note from one of our few coeds, Muriel Bliss Wilbur, who is Coordinator of Health Care Education at Babson College. Gee, I do wish that more of our lovlies would write to me; folks like Kelley-Geddes, Marshall, et al. However, I can assure y'all that our coeds are among our most loyal alumni (ae). Don Newhall announces that he is President of Harwood Engineering Inc., of Norwood, Mass.; is a widower, with two sons, and, better still, three grandchildren. He avers that were anyone inclined to make diamonds, HE would be glad to sell them to Egypt. The point escapes me unfortunately. However, Don can have Musty's address if he writes in for it, with

more class personal news. . . . Dick Warner of Falmouth Mass., announces that he is active in A.A.R.P., local chapter. We do not include any explanation of the alphabeticals, mostly because we don't know what they mean. Sorry we did not get much chance to visit with Dick and Mimi at the 40th, though Leona announced that she had talked with them at length. After 30 years with the V.A. Department of Medicine and Surgery, Bernard Lapidus has retired to consulting work, this time with S.C. Vocational Rehabilitation Department, reviewing claims for Social Security Disability. He gets to Boston a good deal but always at times when there are no reunions. Converse M. Sweetser tells us a very little, but welcome news. It goes like this, "no real news; still with Grumman, have three grandchildren, with one son in the U.S. Coast Guard. "I have retired from Government Service as head of the Engineer-Appraisers, in the Southwest, with the Small Business Administration.

"They were not running the government the way I tole em; "says Russell J. Brooke. He is now with a land development outfit in an Atlanta suburb; Thibedeau Company, Inc. I will not repeat Art Hungerford's story, as it all appeared in a previous issue. Sufficient to say that Art does no more direct teaching, but is interested in experimental education with a group of 28 Colleges, with headquarters at Antioch College in Ohio. We enjoyed visiting with Art and his lovely at the 40th, in fact far too little, as this is a very interesting character. Harry Summer tells us that he just wrote (see interim), and wishes us all good luck at the 40th. Donald R. Smith is now with the Faculty at Drexel University, as Professor and Director of the Engineering Management Program, after many years in the industrial world. He enjoys the combination of teaching, executive, and consulting work. Chuck Fulkerson and Eliz were taking a trip to Mexico last January, it says here. The Fulkersons have three grandchildren; two girls, 2 and 5, in Palo Alto, and a nine-month grandson in Washington, Conn. Chuck retired in 1968, but in 1970, could not resist buying a mismanaged letter business, owned then by a widow. Chuck appears to be enjoying getting the outfit afloat, after much haggling, and a strike by the Teamsters. Chuck, I like this better than coffins or whatever it was earlier. Allen A. Hinkle attended the 40th. He is local manager of an out-of-town mortgage loan banking firm, specializing in industrial loans, "up to 25 millions"

Golly, here's old Bill Pleasants! Gee, I used to get a belt outa this guy, as he is a real engineer. I say used to, advisedly, as I hear from him much less often. Maybe I made a fox pass. I quote, "I am now working as Project Manager for Westinghouse International, water quality control Division, C. O. Bohrer Inc., a subsidiary, on a new Water Supply system for the Republic of Panama.". . . Golly, that guy lives in a lot of places. . . Mac Millard writes that he has retired as of last March, and will live in the Carmel Valley until April

(last), then back to Sewickley, Pa. . . . Bernard D. Lucey announces that he is saving up for his retirement, and hopes to salt away enough to make it about the time of his 100th birthday. I'd say that this guy is studying to be a character. However, how can I lose? I hope he makes both. . . Bill Moran is still with American Cyanamid, in Bound Brooks, Va., and is in Research and Development projects for dyes. Daughter Barbara lives in Arlington, Va., where she teaches music, and, plays in the local symphony. Daughter, Patricia, lives in Laurel, Md., and teaches school in D. C. Irene and Bill live in the Wachung(?) Mts. overlooking Bound Brook, and he has no plans for retirement. Maybe Am-Cyan will make them. The Morans were, as he wrote, just back from an extended European trip.

Sulo Pannanen is still with Bell Aerospace Division of Textron Inc., of Buffalo, as Manager of the Marketing Information Center; planning to retire as of end of 1974. Golly here's one for the book; the man is Master of the Occidental Lodge, F. and A. M. of Buffalo. Look, Sulo, we don't mind you getting fraternal, but we don't want you running the place. What will Murphy and I think? . . . Ed Simpson comes through with plenty, after all these years. He is; Director of Property Sales, Liberty Insurance Co.; Vice President of Liberty International Insurance Co., and the father of quite a few. His daughter, Dr. Beryl Simpson is an Assistant Curator of the Smithsonian Institution; son, Edward Jr., is an architect, planning department of the University of Massachusetts; daughter, Joan; her husband is Dr. Michael Daines, and there are two children, one 3 and the other 2 months.

Gerard M. Kincaide, last seen at the 40th, has a word telling us that he will be there. Gerard retired from St. Regis Paper, as Vice President and General Manager of the container division.

Now for the press; From the Massachusetts District Commission Water and Sewer Topics, we find that our own Alexander J. Minkus, Sanitary Engineer, has been appointed Deputy District Manager of the M.D.C. He will also continue with his duties as Deputy Manager for water supply and purification. Alex has been with the MDC since 1935. Alex is married to the former Regis Lyons, and the couple are blessed with three children.

Ralph Cross, in a release where the "Catalytic Converter" system is taken to task as compared to already exceptional results by Mazda and Honda, agrees that the time allowance is far too little to accomplish by 1975. In passing, the release states that Mazda has already made the 1975 standards without catalysts but has made it at the expense of an added 30 per cent of fuel consumption. On the other hand, Honda has made it equally well and with no appreciable change in fuel consumption. The Cross company is a major supplier of machine tools to the automotive industry. Ralph adds that the Detroit people will need six to seven years to convert completely to the

Mazda-Honda stratified charge engine. From the Harvard Medical School, we have a release which mentions, from the appointment list, our Doctor, Edward R. Loftus. After M. I. T. Ed attended Harvard Dental School, and received a degree in periodontology. Later he was an instructor at the Tufts Dental School, where he became Clinical Professor of Periodontology. In 1968 he became, successively, Research Associate and Associate at the Harvard Dental School. He was in private practice all this time, also. Since retiring from practice, he has been coordinator of educational programs with the Veterans' Administration hospital. Space will not allow listing the dozens of local, regional, and national dental organizations to which Ed belongs. I would add that this looks like a very distinguished career, and we are proud to have Ed as one of ours. The Department of Commerce makes an announcement of a forthcoming conference in Seattle, on "The Oceans and National Economic Development". This conference brought together five to six of the nation's foremost educators in the Marine Sciences. Among these we find Dr. Athelstan Spilhaus, one of the top, perhaps the top, of Oceanographers. Spilhaus is now connected with the Woodrow Wilson International Centers for Scholars, in Washington. He is the originator of the Sea Grant concept, which is like the Land grants, where, federal funds are distributed among educational institutions for the advancement of marine sciences. It is very unfortunate that the proceedings of this sort of conference are not readily available to the general public. I happen to know that Dr. Spilhaus is a member of the Board of Trustees of the International Oceanographic Foundation, of which I, personally am a life member. So, I do get a bit of information quarterly. From the J. E. Greiner Co., Inc., we have notice of the organization of a British subsidiary. Greiner is a firm of Consulting Engineers of Tampa, Fla., and they, apparently are interested in airport design and operation. So, our own John R. Wiley has been made a Director of the British subsidiary. He is, and has been for some time, a consultant for the American Greiner concern. Heck, I thought this guy retired. Well it goes to show that good men can't be put down. . . We have a long interesting release by General Tire Co., in which the efforts of George R. Vila, President and Chairman are written up in magnificent style. The article is far too long for paraphrasing here, but, it turns around George's efforts to get General back in the swim as leaders in the rubber tire industry, among other lines. George is making a determined effort to take the lead in making steel belted tires, and, has only one real competitor-Goodrich. It appears that George is willing to bet better than a million of General's dough that the American buyer will buy steel belted tires even though the cost is twice what they are used to buying. It is quite apparent that this fella George is quite a man. We have a right to be proud of such classmates. We have word from Southeastern Construction Co., that they have made major changes in management; the change that interest us is about Beau Whitton, who now is Chairman of the Board. That doesn't mean that he is retired; though no mention is made of who is Chief Executive Officer. I'll leave it to you to decide after you find out that Earle Whitton, Sire, founded the company, and he retires in favor of his son of whom there are none whomer. Southeastern operates 11 southern states, and has branch offices in Florida, Mississippi, and West Virginia. Beau, as you may have heard, is our southern man on our list of officers. He stayed away from the 40th, so I did not get to meet Daphne, worse luck. (see interim letter).

We have more than enough address changes for y'all, to wit; Herbert C. Endly, Horace L. Newkirk, Edward C. Peterson, Otto A. Peterson, Jr., Lieutenant Colonel Carl U. Burbank, Ellery D. Clark, Thomas K. Fitzpatrick, Munroe H. Kessler, Joseph A. Murphy, Charles F. Payne, Stephen H. Rhodes, Douglas M. Stewart, Edward H.

Rohn, George A. Stoll.

indeed there are any.

Three of ours have passed on since last report; Chauncy W. Raycroft, Basking Ridge, N.J., Harrison L. Jewett, Stoning-Conn., Elton N. Roberts, Concord, N.H. We are all saddened by these passings. If anyone wishes to write to the survivors, the addresses are available without the usual specs. I knew none of these above, in person, but some of you may have. I will write to each widow, if

Please let me add, again, my formal request for more class news. The 40th fund drive is over, and I have suspected all along that some of you have been reluctant to write me, fearing that all I am after is money. All this in spite of the fact that I had very little to do with the very successful campaign. So, to those who did have some fears, let's forget the past and start over again. That's it until later, Best to all of you.-Warren J. Henderson, Secretary, Fort Rock Farm, Drawer H, Exeter, N.H. 03833 Tel.-603-772-2333

I'm back on the job again and sorry that the July/August issue got by without any Notes. I hadn't realized there was an issue then, or I'd have made George Bull do some more work for us. If I may be permitted some personal comments, I would like to say a little about how much we enjoyed our trip abroad. I had been in Europe in 1927 and 1928, but it was my wife's first visit. We're a couple of Anglophiles so I guess we enjoyed best the month we spent in England. We drove some 1800 miles there-managing to stay on the left. My biggest thrill probably was to find that the central part of Paris seemed little changed from before and is still as beautiful. Coming in from the airport was urban sprawl and high-rise apartments but these were areas that I didn't remember anyway from the trips years ago. I don't want to go on at too great length about a vacation but I would mention two things-we walked about in the center of Paris in the late evening

with far less concern than I think we would in Boston or New York; and we encountered none of the alleged rudeness the French were supposed to show to Americans. Maybe it was because we always started with what must have sounded like wild French to them, but at least we were trying. Both in Paris and in driving through the Loire valley we met nothing but friendliness and an effort to be helpful.

To finish off the travelog section I found out in a recent call to Paul Wing that he and Claire are going abroad shortly for a moderate trip. He's lucky-at least part of it will be for business purposes. He also told me the pleasant news that Carl Wilson had remarried and was being sent to England this fall by Foster-Grant and will be over there for about 18 months. After the problems Carl had in the past I'm sure we all wish him much happiness

in his new marriage.

Skipping a generation but staying with marriage for a moment I picked up an item from the Boston Globe that on July 8, Johnny Hrones' son, John A. Hrones, Jr., was married to Cynthia Knowles. The wedding took place here on the Cape in East Sandwich and carries on an old M.I.T. practice-the bride was graduated from Simmons. I'm only sorry that, since the bridegroom's father is probably the most superfluous person at a wedding, Johnny didn't have a chance to let me know he was in these parts.

Now to catch up on some of the items that got missed from the earlier issues. At the end of March I had a letter from Larry Stein. It goes in part "I guess of chief interest at the moment is that I am changing jobs at the end of next week. I am leaving Charles T. Main, Inc., and joining United Engineers and Constructors (Jackson and Moreland to those in the know). I think it is a move in the right direction because at least it is ten minutes nearer home! Jerrie is head of the media center at North Quincy High School with the title of Head Media Specialist. She loves her work dearly and I for one would recommend to any bored housewife whose children have almost grown up to get out of the house regularly. "A quick word about our children, Debbie and Robert are each married, April is a Junior at University of Massachusetts and Lauren is stuck at home with us. She is a ninth grader.

"Last summer we went to Prince Edward Island to see our fourth (and my sixth) total eclipse of the sun. We had a marvelous time and it was beautiful. We have not made plans for this summer yet, but hope it will be a good one." . . From the Portland, Maine Express came an item in March that George Best had been named Vice President and Secretary-Treasurer of the Manufacturing Chemists Association since 1959. . . Also from that time are some Alumni Fund notes. James A. Sweeney writes, "From January 1, 1972 to June 30, 1972 did consulting job for McDonnell Douglas Automation Co., on contract requiring everyday service; still on open contract with company but presently doing regular employment; 12-18 months job for George G. Sharp, Inc., naval architects, in field office at Sparrows Point, Md." . . . The other comes from Katherine (Seidensticker) Lemon in Canada, "My husband and I have spent the last five or six years travelling, mostly in our compact travel-wagon. We have three children all married who have blessed us with five grandsons. Our son, a graduate of U.S.B., is employed by the Atomic Energy Commission of Canada at Chalk River (two sons). Our oldest daughter (one son) is an R.N. Our youngest daughter (two sons) housewife and mother."

When I read this I was struck by an odd thought-Mrs. Lemon is the second Canadian woman of our Class who has sent in Notes of this nature. When you consider how few Canadian women (or women now living in Canada) there probably were in our Class, they surely must be setting a record on a percentage basis. If the rest of you came close to this, I would never have to face any lean months. (Maybe the foregoing sounds like some of the baseball announcer's strained statistics, but it's really meant as a compliment).

Now, unfortunately, I must come to write of several losses we have experienced or learned of recently. In each case I have only the name and date of their death and so cannot tell you more than this. Joseph F. Pepi died in March of 1967; M. Scott Dickson, March 17, 1972; and Samuel L. Benedict on February 28, 1973. On behalf of us all I would extend our sympathy to their surviving families. It is particularly disturbing to me that our contacts with some of you are so tenuous that, in the case of Mr. Pepi, six years would pass before we learned of his passing.

Coming back to more pleasant news, in April 1971 I wrote about the award to Gil Lorenz of the Exceptional Civilian Service Medal, the army's highest award to a civilian. I have now gotten word that in June, after 37 years of military and civilian service in the Corps of Engineers, Gil has retired. At his retirement he was Technical Director of the Topographic Laboratories. Gil and his wife Thelma live in Alexandria, Va., and have a daughter Julie and a son, Gilbert M. Lorenz. I have several recent Alumni Fund notes but I'm going to hold all but one for our next issue. I want to quote from it now because to me it finishes on a really up-beat note. It comes from John Newbegin and reads, "Don't remember if I reported moving from Sheridan Co., to S. I. Handling Systems, Inc.-builders of automated conveyor-storage-recovery systems. Have had my wings clipped after contracting spinal meningitis 22 months ago. I seem to be recovering." What I can't reproduce here is the final, now-classic round smiling face. With that kind of spirit I'm sure Johnnie's recovery can't be anything but satisfactory.

One final item for the moment. It's not too soon to remember that next year will bring our 40th Reunion. At last check, we still have a solid reservation at the Wychmere Harbor Club in Harwichport (the scene of our 30th). So start to include it in your planning for 1974—the dates are May 31, June 1 and 2.-Robert M. Franklin, Secretary, Satucket Rd., Brewster, Mass., 02631; George G. Bull, Assistant Secretary, 4961 Allan Rd., Wash., D.C.

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Another of our classmates is launching a new career: Mortimer Rosenbaum wrote through the Alumni Fund "after retiring from the field of Aeronautics and astronautics. I decided to return to school. Having now completed the required three years of Law School, I anticipate launching a new career before the end of 1973." . . Other notes were received from the following: Blake D. Mills, Jr., who reports that he is a Professor of Mechanical Engg at the University of Washington. . Philip H. Rhodes relates of his visit this last June to Richardson, Texas to see his oldest grandson graduate with honors from high school. . . . Philip H. Rhodes III will enter Southern Methodist University as a Sophomore this fall. . . . Kenneth M. Warren writes, "Planning to retire September 1, 1973. Currently Assistant Vice President of Allendale Mutual Insurance Co., Johnston, R.I. Have been associated with the Factory Mutual System for 31 years."
You will be interested in learning that

You will be interested in learning that Carl Kock is Chairman of the Board and James S. Craig, '46 is President of the Boston Waterfront Development Corp., which is owner and developer of the prestigious Lewis Wharf development.

In recognition of his life-long efforts to advance scientific research and the practical application of new technology, Charles S. Schauer, Executive Vice President of Research Corp., of New York City, received an honorary Doctor of Science degree from Southwestern at Memphis during their June Commencement exercises. After seven years with Philadelphia Electric Co., and four years with the Office of Scientific Research and Development, Chuck joined the Research Corp., Foundation in 1946 as Associate Director of Grants. Since 1968 he has been responsible for overall foundation administration. He and his wife Jean live at 2 Vermont Ave., White Plains, N.Y. Randy Antonsen, Class Treasurer, and Bernie Nelson and wife Rhoda attended the 25th Anniversary of the Mexican Fiesta. Incidentally, Randy reports the class treasury is in good shape. . . . Earle Megathlin is now a Sales Associate in the Commercial-Investment Real Estate Division of the Crisp Co., in St. Peters-

Class President Bob Forster will report the detailed results of the Class Poll conducted a year ago to determine, among other things, the attitude of the class on election procedures in an attempt to find a way to get more participation. But here are some of the highlights. Of the 456 questionnaires sent out only 64 returns were made. That in itself is a good indication of why any attempt to make changes, it seems, would have very little effect in increasing class interest, and why the current methods will probably be continued. There were 39 votes for no change and 24 votes for change. There was an even split in the voting to organize regional groups and a 33 to 22 approval of the appointment of Assistant Class Secretaries and in each case 23 said they would help. 29 voted for a 40th Reunion Class Book and 28 said they

would help with it. The next job for the Class Officers is to implement all the positive votes. We should have more on this in the next Review.

The Class Golf Tournament is getting down to the wire. The Finalists for this thirteenth year will be the winner of the Leo Beckwith-Bill Bates match vs. Art Marquardt who took me over the bumps for a 1 up win last Saturday at Brae Burn.

At the Alumni Day Luncheon, we were represented by the following attendees: Jane and Peter Grant, Rufus Applegarth, Leo Beckwith, Bill Klehm, Nelson Thorpe and Allan Mowatt. Rufus told us an interesting bit from his undergraduate days; In 1934 he demonstrated a stereo system in Building 10 and wrote a paper on it. He flunked the course or that project and the comment on his paper was that it was too far out and would never amount to anything! We can't win them all.—Allan Q. Mowatt, Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

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Alumni Day records show that Ed Dashefsky, Leo Kramer, August Mackro and George Parkhurst were in attendance at some time. I saw only the Parkhursts at the luncheon on Monday, having spent the previous day driving home from Toronto. George is in charge of donor recruitment for the Blood Bank at Massachusetts General Hospital. It is the largest hospital blood bank in the world. requiring 36000 donors each year. Extracurricularly he is Chairman of the Bicentennial Commission for the Town of Chelmsford, Mass. . . . Barbara Parkhurst is a parasitologist in the Infectious Disease Unit at M.G.H. . . . Mal Graves reports that he has earned his M.A. from the Graduate School of Corporate and Political Communication at Fairfield University and has embarked on a consulting assignment for Yale University at the Connecticut Mental Health Center in New Haven. . . . Larry Peterson ("Pete" is not a definitive appelation under the circumstances, since the Class has several by that name) writes from Schenectady that after more than 36 years with General Electric he has retired. His most recent responsibility was as Manager for Finance of the Microwave Tube Operation. . . . Dorian Shainin has been promoted to Senior Vice President of Rath and Strong, Inc., a Lexington-based management-consulting firm. The Shainins live in Manchester, Conn., and Dorian is a Faculty Associate of the School of Business Administration at the University of Connecticut.

The Alumni Office has reported the death of Stacy Carkhuff of Topeka, Kan., in April, 1971. No further information is currently available.—Alice H. Kimball, Secretary, P.O. Box 31, West Hartland, Conn. 06091

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Our class was represented on Alumni Day, June 1973 by Doug Carter, John Fellouris, Win Gay, Joe Heal, Phil Peters, Mel Prohl, Joe Sousa, Bob Thorson, Ralph Webster and Walt Wojtczak. All with their respective wives. The mini-reunion was very successful, followed by the International Buffet and the Boston Pops. Hope more of our class will be in attendance in the future.

Joe Keithley has assumed the position of chairman of the board of Keithley Instruments. Joe will still be active and work in the shop full time. . . . Channellock, Inc. has been named winner of the fifth annual Harry C. Wilson Award which is presented annually to the person or organization who best promotes economic growth in the Meadville, Pa. Area. George deArment, president and coowner of the company received the award on behalf of Channellock, Inc. Channellock earlier this year announced plans for a new forge shop which is now under construction. . . . Frank Lewis is now chief electronics engineer at Jas. Millen Manufacturing Co., Inc., Malden, Mass., after retiring from General Radio Co. in 1969. As he writes "real retirement seems a long way off. My health is darn good." Frank has one son at Carnegie-Mellon University, one son at the Institute and a daughter at home. . . . Jim Ewell writes that all is well and he now has two grandchildren. . . . Dan O'Conor has retired as vice president of American Cyanamid Co. and now lives at Blue Mill Rd., Morristown, N. J. 07960. . . Mel Hitchcock also has retired after 36 years with Union Carbide. . . . Norm Birch writes "the switch to what turned out to be semi-retirement was a cinch. I have had no adjustment problems and Elvie doesn't mind having me around a bit, I highly recommend it. Am now self employed as an industrial consultant and my present clients are Portugal, Brazil. and 'sometimes correspondence' with Australia."

It is with pleasure that I announce that Les Klashman, assistant class secretary, was remarried in Peabody, Mass. on July 29 to Mrs. Pearl Lodgen. Best wishes from all of us, Les. Les and his bride are now living at 198 Maple St., Malden, Mass. 02148. . . . I have also received announcements that Phil Peters' son, Philip Homer Peters, Jr. was married on June 2, to Tamie Amerman Griswold and Walt Wojtczak's son Richard Walter Wojtczak was married on July 14 to Nancy Wertheim.

It is with sadness that I report the death of Quentin Berg on July 20. Quentin was the found of Berg Electronics, New Cumberland, Pa.—Robert H. Thorson, Secretary, 506 Riverside Ave., Medford, Mass. 02155; Lester Klashman, Assistant Secretary, 198 Maple Street, Malden, Mass. 02148

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The big, but belated, news of the Class is the Class Reunion held at Stratton Mountain at the beginning of June. Reunion Chairman, Paul Black did an unbelieveable job of planning in that he really did give us the beautiful weather that he had promised in his advance publicity. The Reunion Banquet included the election of new officers for the next five

years.

Norm Leventhal is now President of our Class, Paul Black is Vice President, I was not able to get out of the job of being Secretary nor was Ed True able to get out of the job of being Treasurer. Frank Kemp was reelected as Class Agent. Bob Johnson, who served so ably as President for the last five years, now joins the ranks of distinguished Presidents Emeritus.

Harry Hollander sent in a note apologizing for being unable to attend the 35th Reunion, the reason being that he had teaching responsibilities at that time. Harry has finished his second book Plastics in Jewelry. . . . A few lines from Al Clogston: "As of April 1, 1973 I have returned to New Jersey from New Mexico where I was on leave of absence from Bell Labs as Vice President Research, Sandia Laboratories. I am now Executive Director Research, Physics and Academic Affairs, Bell Telephone Laboratories, Murray Hill, N.J. On April 24 this year I was elected to membership in the National Academy of Sciences." . . . Gus Rossano writes: "I have just complete my tenth year at the University of Washington in Seattle as Professor of Air Resource Engineering. It is most satisfying to see how well our graduates are succeeding in the real world. Four of our Ph.D.'s are now associate professors at other universities. Our eldest son and daughter are married and we have two grandchildren. Margie is Director of her own preschool-the Bellevue Montessori School which just moved into a new building, specially designed for her . . .

One of the less pleasant duties of a Class Secretary is to report those members of the Class who have passed away. As age starts creeping up on us all, this occurs with increasing frequency. I recently received word that Shep Roberts had passed away last November, leaving his widow Muriel. . . Thom Evans died last February in Bettendorf, lowa after a year's illness. Our deepest sympathy to the their families.—A. L. Bruneau, Jr., Secretary Hurdman and Cranstoun, 140 Broadway, New York, N.Y. 10005

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To begin this year's series of '39er Notes, congratulations are certainly well-merited for two who have furthered their

advanced education recently: Eli M. Dannenburg was awarded the degree of Docteurdes Sciences Physiques with special honor by Le Centre Universitaire Du Haut-Rhin and L'Universite Louis Pasteur De Strasbourg. His thesis dissertation was presented in French on July 12 at Mulhouse, France, with the title of "The effects of surface chemical interactions on the properties of filler reinforced rubbers." Dan wrote that he is probably the last guy of '39 to receive a doctorate, and that it is rather hard to believe that it has been 34 years since he received his bachelor's! Dan wrote from the Billerica Research Center of Cabot Corp. He did not list a corporate assignment or title, but the enclosed news release contained the further information that Dr. Dannenburg is the 1973 Chairman of the Rubber Division of the A.C.S.

Congratulations also to Creighton B. Olson who noted briefly that he received a B.S. in Education in June '72 and his M.S. in Educational Administration in June '73, both from Southern Illinois University at Adwardsville, Ill. . . . Did any of you see Massachusetts Governor Francis Sargent on NBC's Today Show on August 22? He was interviewed live by Frank Magee on his stand concerning Massachusetts' participation in a Federal Computer information bank on criminal activities. Sargent was not against the rapid sharing of correct information, but he expressed serious concern about the possible misuse of information once stored and the current impossibility of removing data for persons not convicted.

Lucille and I attended part of the Alumni Day activities-very enjoyable and enlightening and the following is a not necessarily complete list of '39ers who participated: President George Beesley and Eleanor; Treasurer Ernest Kaswell and Yolande; newly-appointed 35th Reunion Chairman Frederick Schaller and Anne; Class Agent Seymour Sheinkopf and Sylvia; Aaron White and Edith; Evelyn and Harold Hindman; Paul Stanton; Mr. and Mrs. John W. Krey; Mrs. Olive Cohen (widow of Irving); and Mrs. Judy Lucas, (widow of Phil). It was great to see our good group and it was especially good of Olive and Judy to make the effort to attend. We will all be hearing much more from Fred Schaller during the next few months, for June 1974 will be fast approaching. Make plans early to attend.

We haven't heard much from Alphonse J.

Graffeo for a long time, but the following is quoted verbatim from his reply to an Alumni Fund mailing: "On Feast of Christ The King, 1966, I assumed Vow of Poverty, having given all I possessed to the poor except for clothes and books. I help anyone who comes to my door for help." . . . Gus M. Griffin noted that "Griffin Chemical Company is still alive and active in water treatment, etc. Have added a 'bubble factory' in Owensboro, Ky., turning out shampoo, bubble bath, etc. Free samples to '39ers. Daughter at University of Indiana. Son entering University of South Carolina." (Reunion Chairman Fred Schaller: Take note of that sample offer.—Oz)

Lawrence Perkins wrote that he is President and owner of the Connecticut Construction Corp., North Haven, Conn., and the Mass. Construction Corp., of Marlboro, Mass. He is also father of three and Grandfather of three. . . . Robert C. Casselman has been elected a Senior Vice President and Director of Rath and Strong, Inc., Lexington, Mass,. and heads the newly-formed Government and Institution Services Division, to provide specialized consulting services at all levels in all areas of public management. Now Bob will carry his streamlining of state government to state capitals across the country, leaning upon his four years of Massachusetts work.

Further detailed in the Review, but of special note to our Class: Professor Louis D. Smullin, Head of the Department of Electrical Engineering, has been appointed as Dugald Caleb Jackson Professor of Electrical Engineering, effective July 1.—Oswald Stewart, Secretary, 3395 Green Meadow Circle, Bethlehem, Pa. 18017

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It is with regret that I must report the death of two classmates: Colonel Percy H. Brown, Jr., who received his B.S. in Course II died on March 8, 1972, Owen Matthews who received his B.S. in Course IX-B, died on December 13, 1972. At the time of his death, Owen was living in Portland, Ore. The latest information of Owen's career was that furnished for our 25th Reunion book where he advised: "Employed as a Technical Engineer for Alcoa in construction of new reduction plant June 1940-42 at Vancouver, Wash.,

1942-44, same thing for new plant at Troutdale, Ore. In U.S. Navy, from 1944 to 1945. Married Oregon girl—Carol Birum in navy Chapel, Washington, D.C. October 21, 1945. January 1946 started work with William S. Turner and Co. as a sales engineer. Went into business for myself on September 16, 1961. At present I represent Air Devices, Inc.; Cambridge Filter Corp., and Koppers Co., Inc. selling diffusers, registers, grilles, roof exhausters, high efficiency air filters, sound traps and soundproof enclosures. Three wonderful girls—wife and two daughters."

George Kosco and his wife attended the 25th anniversary of M.I.T. Club at Mexico City in April. . . . I. M. Pei is the architect at Kennedy Presidential Library to be built in Cambridge. . . . Millard Dowell, who recently retired as an engineer from G.E. was awarded the Erie section of the A.S.M.E. "Man-of-the-Year-Award". Milt had been with G.E. over 42 years and is the inventor of 10 patents on fans, jet engines and diesels. One of the patents is directed to fuel cooling of jet turbine plants and is used on almost all jet engines today. Francis "Jack" Bittel of Poland, Ohio, who now resides at 33 Jennifer Dr., was recently named director for marketing for Youngstown Steel: formerly he was General Manager of Sales. . . . Stewart E. Miller has been elected to membership of the National Academy of Engineering. He is with the Wave Research Lab of Bell Telephone Labs.

Bob McKinley has been elected Director to the American Society for Testing and Materials (A.T.S.M.) for a three-year period. Bob originally worked for Sylvania Electric, Lighting Division, then joined the Westinghouse Lamp Division and in 1942 was an electrical engineer with the U.S. Navy Department. In 1953 he joined P.P.G. Co., as a technical representative and in 1965 he became Manager of the Technical Services (glass division) of P.P.G. Industries. . . . Bob Millar notes "First daughter is a graduate registered nurse in Central Vermont Hospital. Two children in high school youngest child in sixth grade." Bob Heiss comes the news: "My older son, Tom, has done us proud by winning a Merit Scholarship. He's been accepted by Tech, but isn't sure whether he'll go there or Princeton. He will be studying architecture. I am keeping busy monitoring new products for the headquarters of the System Products Division of IBM. Manage to fill my spare time as scout master of Troop 13 in Stamford, Conn. . . . Dr. Louis Berger is a seasoned world-traveler as indicated by his brief notes: "Leaving on trade promotion tour (an annual event I attend) with the Vancouver Board of Trade in April to visit Prague, Warsaw, Budapest, Sofia, Varna, Bucharest, Vienna. Last year's trip took us to Australia, Indonesia, Hong Kong, Every year we make new and rewarding business connections abroad.

Robert Seedlock is now Deputy Project Director for Parsons Brinckerhoff-Tudor-Bechtel, General Engineering Consultants to Metropolitian Atlanta's Rapid Transit Authority for design and construction of Atlanta's 1.3 billion rapid transit program.

. . . James Boulger is an architect with his office in Salem, Mass.

Those classmates and wives attending the festivities of Alumni Day included: Mr. and Mrs. Ed Bernard, Mrs. Robert Bittenbender, Mr. and Mrs. John Danforth, Mr. and Mrs. Russ Haden, Mr. and Mrs. Ralph Hayward, Mr. and Mrs. Herb Hollomon, Mr. and Mrs. Bryce Leggett and guests, Mr. and Mrs. Rich MacPhaul and Mr. and Mrs. Don Richardson and quests.

Your Secretary and wife Norma spent a delightful 25-day vacation in Europe this summer celebrating our 25th anniversary. We visited London, Amsterdam, Koblenz, Frankfurt, Munich, Salzburg, Vienna, Venice, Lucerne and Paris. The only bad feature of the trip was the huge amount of work awaiting me when we returned. For more news, write to AI.—Alvin Guttag, Secretary, Cushman, Darby and Cushman, 1801 K. Street, N.W., Washington, D.C. 20006

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Mark Kravitz has recently been appointed to the Hartford National Banks Manchester area Advisory Board. The article gives us a very impressive run down of Mark's extra-curricular activities-Trustee of the Manchester Memorial Hospital and of the Puerto Rican Workers Insurance Fund. He also serves as a member of the Labor Advisory Committee of the Migration Division of Puerto Rico and as a Director of the National Council of Agricultural Employers. . . . Gene Hanszen has re-cently returned from India where he was a consultant for Zucri Agro Chemical Co., in the construction of its new fertilizer complex. . . . Jack Williams writes that he is still European Vice President of Studebaker-Worthington and he is spending most of his time looking at acquisitions. Jack says that Brazil has been added to his "beat" and so he is currently commuting from Paris to Rio and to San Paulo.

Our column is running almost a year late on this, but Bob Keating was promoted to Vice President-Finance of Susquehanna/Western, Inc., and transferred to San Antonio last December. We are slightly more current on Bob's additional appointment as Texas District Manager of Susquehanna/Western last April. Bob writes that the principal business of this division is mining and milling of uranium ore for electric utility companies. . . . Russ Estelle has left Neptune and is now Manager of Engineering at Gammon Calumet Industries in Florence, Ky. . You certainly did not read it here first, but Robert Seamans, who received his S.M. with our Class was recently elected to a one-year term as President of the National Academy of Engineering after completing his term as Secretary of the Air Force.

Filo Turner writes that his oldest daughter, who is now 13, is busy winning blue ribbons with thoroughbred jumpers and hunters. His other four youngsters also are busily horsebacking. Filo is still raising Chevrolets as a business and some cattle and a little Cain—once in a while.

. . . Cutler-Hammer announced that Al Waggner was appointed Vice President in charge of financial management and ad-

ministration for A.I.L. Division in July. Al has been with Cutler-Hammer since 1961 in various technical and management assignments.

Fred Sargent, who was with our Class as an undergraduate and received his M.D. from Boston University, has been cited as one of 16 outstanding Boston University school of Medicine graduates during the last half century. Fred's award was for his "pioneering efforts in the fields of environmental health and human ecology over the past two decades." Fred has taught at the University of Illinois, University of Wisconsin, Western Washington State College and is now on the faculty of the University of Texas. He has sure been around the campus scene. We add our sincere congratulations for

this outstanding award.

We thank **Ed Thode** for a long and newsy letter. Time goes by and next month he completes 10 years as Professor of Chemical Engineering and head of the Chemical Engineering Department at New Mexico State University. Ed's daughter is teaching in East Corinth (Maine) High School and his son Stephen is serving in S.A.C. as a missile officer while Jonathan, still in High School, is rebuilding a 1936 Dodge. It looks as though there is still one more engineer among the Thodes. . . . One interesting bit of news from Ed is that Bob Given is living in El Paso and operating wholesale hardware business. Apparently his company is one of the few places where you can still buy a good old standard windmill. So if any of you need windmills, get in touch with Bob!

Ed Vetter has been elected to the Corporation. . . . Hugh Schwarz has been elected Vice President of the Alumni Association, while Paul Hotte and George Schwartz have been elected to the Alumni Association's Board of Directors.

Lets hear from you all.—L. K. Rosett, Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

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When a fellow like Kemp Maples greets you at the reception desk with a hearty handshake and can of cold beer, what better way is there to start a class reunion? And a grand reunion it was under the expert guidance of Chairman Jean Hartshorne, aided by Leo Feuer, Gene Eisenberg, Jim Hoey, Howie Mattes, Jim McDonough, Hans Walz, Ken Warden, and, as heretofore mentioned, Kemp Maples. About 60 showed up, most with wives, all in good condition, as evidenced by some tournament-class tennis games and some strenuous sun bathing sessions. Long distance honors went to Al Emond from Oregon, and foreign country honors went to Fred Kaneb from Canada.

Eisenberg did his usual bang-up job as hat and gift chairman: the women's crew hats never arrived; the 60 one-half dozen highball glasses came in at 60 dozen, and the hard hats were too small, again. So if you want some highball glasses, Jim Hoey has cartons of them in his wood shed at Chathamport, at \$5.00 per half dozen. Official returns of the class election, subject to audit, are: President,

Ken Warden; Vice Presidents: Jean Hartshorne, Kemp Maples and Bob Secretary-Treasurer, Rorschach: Feingold; Class Agent, Jim McDonough, and Special Gifts-Estates, Stan Proctor. We are extremely pleased with Ken, Warden's ascension to the Presidency; he has evinced great leadership in our class affairs for many years. The Class gave a rising vote of thanks to retiring president Jim Hoey, whose 20 years in office has been evidenced by the warm and sincere comradeship and high class spirit which our class has. Jim was presented a ship's bell clock, suitably engraved. Thanks, again, Jim, for your fine leadership.

Bud Greenwald, President of Hart Engineering Co., of East Providence, R.I., has formed a new company, Herzog-Hart Corp., to provide owners of heavy industry with a single source for carrying out expansion plans. . . . Russ Coulson called Ken Warden on his way through Boston in July, to report that he was vacationing in Martha's Vineyard and New Hampshire; that four out of five of his children are in or have completed college; and that he keeps busy with his consulting work in Denver. . . . Bill Holway reports that he recently took office as President of the Consulting Engineers Council of the United States, which is now merged with the American Institute of Consulting Engineers, and called the American Consulting Engineers Council. . . . Captain Baret Ajemian, U.S.N., retired recently at a ceremony in Boston. You may recall he transferred to the Naval Academy during our undergraduate years. . . Other navy news, reported by Malcolm Walker, is that Dick Henning is a Rear Admiral, and still active in Naval Ship Systems Command, and is one of the few non-Academy officers to be promoted to Rear Admiral. Malcolm is with General Dynamics in Quincy, Mass., and is currently president of the Braintree, Mass. Historical Society, which operates the General Sylvanus Thayer Birthplace, an authentic reproduction and a Massachusetts Historic Landmark. He is also a trustee of the Braintree Savings Bank. Good to hear from you, Malcolm, more letters like yours keeps the spirit up!

Clinton Kemp wrote us that he has joined InterTechnology Corp., as its Vice President. This is an engineering consulting firm specializing in energy fuels, fuel production and related matters, and particularly environmental problems. Clint is the co-author of a fine article which appeared in Chemtech in May, entitled "Energy forests and fuel plantations"-which asks the reader to consider acres of growing greenery dedicated to fueling a steam-electric power plant-a convincing argument against nuclear power. . . . Lois and Stan Proctor attended the gala 25th anniversary of the M.I.T. Club of Mexico City's annual Fiesta last March. We wonder if they saw classmate Jorge Rascon there, who wrote us recently that he is engaged in Mexico City in the design and construction of meat packing, refrigeration and freezing plants. . . . Professor Nathan Sloane, who received his master's with our class, has been appointed a Visiting

Scientist at the Harvard School of Public

Sad news concerns the deaths of Kenneth C. Vincent, who was senior process engineer for the Ralph M. Parsons Co., Los Angeles, and of Bernard Helfand, who was a commercial pilot and instructor in Tiburon, Calif.

Back to thoughts about that glorious Reunion: Bailey Neider again provided us with an unlimited supply of cold beer; one classmate arrived by seaplane, and gave many brave souls demonstration rides; class pictures were ordered at \$5.00 each, but none have been received yet; Bill Laird, who is an academic dean at University of Pittsburgh, wore the brightest and most outlandish outfits, as usual, and the clambake, the cocktail parties and the banquets were superb.

I was fortunate to have been able to visit with E. J. Tan in Singapore last March. Tan is a prominent industrialist and banker there, and Vice President of the Singapore Chinese Chamber of Commerce. He and Mrs. Tan are most gracious hosts, and told us that they are always pleased to hear from classmates who visit Singapore. His office address is: Amcol Electrical Industries, Ltd., 7, Kampong Kayu Road, Singapore 15.

During the past five years most of these notes have been written by "Smiling Jack" Kelly, as Associate Secretary. Jack is President of Butterworth System, Inc., of Bayonne, N.J., and his work has taken him on trips around the world many times. Because of his extensive travels he has sought, and has been granted, relief from this awesome task, for which we are either grateful or saddened, as the case may be. But his leave of absence will terminate soon, because he and Chris Matthew are going to guest write, or ghost write, these Notes now and then, starting next year. And as for yours truly, back in the saddle again, now practicing law in Santa Barbara, I extend my thanks to the Class for the beautiful pewter bowl, suitably engraved, presented to me at the Reunion, expressing gratitude to me for my 20 years of service. Write often!—Richard M. Feingold, Secretary, 3757 State St., Santa Barbara, Calif. 93105

With the help of my good wife's diary we shall reconstruct the mini-reunion held the first week of April in Spain. The attendees: Louise and Tom McNamara, Elaine and Bill Shuman, Jan and Charlie Patterson, Dee and Frank Gallagher, Mary and Jerry Quinnan, Nancy and Charlie Hart, Joan and Paul Hirtle who are friends of the Harts, as well as Fran and myself. Last minute drop outs were Jean and Chris Boland as well as Billie and Al Bowen.

And now for the whirlwind tour: Friday, March 30 Logan to J.F.K. and on to Madrid. All but one managed some sleep en route; the one, Mr. Frank G. who was all too busy entertaining the girls, young and old alike. Saturday found fouled arrangements in Madrid but after the usual 2 and one-half hour wait, a comfortable hotel, a snooze, a little sightseeing and

on to Malaga followed by exciting rides in our rented cars to our beach view (not front!) hotel in Torremolinos.

Sunday April 1 proved to be a restful day: church, Bloody Marys, wine and cheese lunches, leisurely strolls at the native beach and then the bull fights which proved a bit unsettling for a few girls.

Monday was drive day for many with several traveling to Granada. We, that is Elaine and Bill Shuman and ourselves, only traveled along the coast for between a flat tire, two hours in Nerja, and wineand-cheese lunch in a deserted fishing village plus a nap along side the road made the day long enough.

Tuesday April 3 was a fabulous day despite its confusing start. Monday Jerry Quinnan had been charged with the responsibility of arranging a day in Tangier and Jerry did his work well except we sailed from Malaga at 8:00 A.M. for a fivehour trip (each way!) rather than the 40 minute from Algeciras advertised. Be that as it may the two five-hour trips plus twohour stay were a barrel of fun. At last report the ferry and its passengers have recovered; I expect to recover my trip expenses once my tell-tale photos are

Wednesday for the most part was a leisurely day back in the country before our return to Madrid. The day ended with our entire group closing the Casa Paco restaurant in old Madrid.

Thursday's sightseeing tour was Interrupted by broken windows, flying glass and frayed nerves as our tour bus battled striking students at the University of Madrid. Thursday afternoon the girls all managed to locate Madrid's finest shops.

Friday we went to Toledo riding South from Madrid across the Plain of Castile filled with groves of olive trees. Toledo Is old and most attractive and unusual; suffice to say it looks exactly like its pictures; i.e., the Cathedral, old Synagogue and the home of El Greco. Friday evening (and night!) it was the flamenco dancers followed by an early Saturday departure

Yes, we had a great time and now back to the world of reality such as the news that Nick Mumford has re-married and now lives in Rochester, Mich. continuing, if you will, at LTV-Michigan. . . . Or Max Ruehrmund spent the first two weeks in April in traction as he recovered from a slipped disc. . . . Or Matthew 'Red' Harrington is back-after an eight year absence-to Shell headquarters in Houston. . . Vince Butler after a life time in San Francisco has abandoned the big city for the more relaxed life in Santa Cruz, Calif. . . . Or Alan Mencher, Science Attache, American Embassy, London edits Volume 1 of Management and Technology, an Anglo-American Exchange of

One could add that our Class Telethon from Cambridge in mid-April was a great success especially the reward to those calling; i.e., the thrill in getting a pledge from a no-no of 20-25 years. Vince Butler reports on a couple of '46ers you will all remember: Hillman Dickerson, now a Brigadier General with such specialities as Physics and Tank Warfare. . . . Warren Chapman is Professor of Urology at Uni-

versity of Washington. . . . James Speaker continues at Hewlett-Packard in California. Jim's daughter, Leza, made her way home from college in Japan this past summer by going West! . . . Ray McDowell is a partner and Vice President of a California manufacturer's representative business specializing in electromechanical area; name: Sales Engineers, Inc.! . . . Dave Mintzer was elected Vice President for Research and Dean of Science at Northwestern in mid-June succeeding Walter Owen who came to the Institute as head of Metallurgy and Materials Science Department on July 1.

Alumni Day '73 attendees were: The George Bermans, Al Bowens, Charles Harts, Tom McNamaras, Bob Maglathlens, and Clint Springers plus Homer Eckhardt, Art Miller, Warren Miller and Ed Stoltz, the latter all the way from Colorado .-C. H. Springer, Secretary, P.O. Box 288,

New Castle, N.H. 03854

Edward T. Clapp has written us to announce his retirement from the U.S. National Weather Service after thirty-two years of service. Ed began his tenure in 1941 at Portland, Me., the first of several stations he was to serve. The Atlantic Weather Patrol was Ed's assignment from 1944 through 1945, followed by attendance at M.I.T. from 1945 through 1946. Other assignments during the following years were at Washington, D.C., Honolulu, Boston, Cincinnati, Burlington, Vt., and finally D.C., again where Ed completed his final assignment as Aviation Forecaster at the Forecaster Office.

As the mail continues to be light we thought we would share two of the biographies printed in the 25th Reunion Book. . . . After leaving M.I.T. Weems E. Estelle taught E. E. at the University of North Carolina and received his M.S. in E.E. at that university in 1949. Weems spent the next five years teaching E.E. at the U.S. Naval Academy at Annapolis. This assignment was interrupted when Weems was recalled to active duty in the U.S.A.F. during the Korean War. Weems became Chief Engineer of T. A. Edison, Inc., until three friends and he founded the Data Control Systems, Inc., in Danbury. In 1968 Weems founded the General Science Corp. in Bridgeport, Conn. They are designers, manufacturers and marketers of diagnostic medical instrumentations. Weems, his wife and children, live in Southport, Conn.

James E. Finigan has spent his years following graduation working in the construction field. Beginning in 1946 his first position was as design engineer for Maurice A. Reidy, Engineer of Boston. After four years in design of bridges, buildings and foundations, Jim joined the firm of J. J. Powers in Cambridge. Jim moved from job manager to superintendent and to vice president of this firm working in diversified construction work including industrial plants, retail stores, office buildings and churches. Jim resigned his position in 1957 to found his own firm of J. E. Finigan, Inc. During the next ten years this firm completed many heavy building contracts in Massachusetts. Jim retired as a General Contractor in 1968 and has become a superintendent with the Boston office of Turner Construction of New York.

Jim and his wife, Elizabeth, and seven children live in Concord, Mass., but much of the winter is spent at their chalet in Gunstock, N.H., where the family can enjoy the skiing season. . . . Louis B. Barber served as a Naval Officer following graduation from M.I.T. but returned to Boston upon completion of his tour of duty. In 1948 he joined Henry L. Wolfers, Inc., a Boston lighting fixture concern. For the past five years Louis has been President and Chief Executive Officer of this concern. In June of this year Louis and Mr. Edwin H. Wolfe acquired the firm from Mr. Wolfers who has retired.

A note from James Ray reports he is technologically unemployed as a specialist in space system test management. He would like to find a connection in environmental or urban planning work and would appreciate anyone who could help to write him at 16344 Englewood

Ave., Los Gatos, Calif. 95030.

Colonel Hillman Dickinson is returning to Washington, D. C. this fall for a year at Brookings Institute. . . . Ralph K. Joslin is now employed with the Equipment Division of Raytheon Co. Samuel Meerbaum received his Ph.D. in Biomedical Engineering in June, 1971 and is now doing research in Cardiology at Cedars-Sinai Medical Center in Los Angeles. Samuel was elected to a Fellowship in the American College of Cardiology in February, 1973. . . . Dr. A. Robin was awarded a Ph.D. degree in Fluid Dynamics at the Catholic University in February, 1973. . . . Felix E. Browder. Professor of Mathematics at the University of Chicago has been elected to membership in the National Academy of Sciences. . . Frederick J. Ross, Jr., Group Vice-President of the Carborundum Co., has been elected to the Executive Committee of the American Supply and Machinery Manufacturers Association.

We would appreciate very much if those of you who have not been mentioned in the Class Notes recently would write us telling of your activities, work, family, etc. We have learned the members of the Class are very eager to hear from you.-Russell K. Dostal, 18837 Palm Circle, Cleveland, Ohio 44126.

Our 25th Reunion of classmates, their wives and their children generated an atmosphere of personal warmth as we renewed old friendships and caught up on each other's activities. A number of new friendships were created and it was a common experience to realize that the people we were with could understand our thoughts.

The pleasures of good friends were enhanced by the sunny cool day at the Essex County Club on Friday. The 'early-bird" bus took the golfers to the club and a later bus under the direction of John Reid toured the North Shore en route to the Club at Manchester.

Tennis attracted the most people in-

cluding Gloria and Sonny Monosson, Ann and Ken Brock, Betty and Malcom Reed, Nancy and Bill Zimmerman. Joan and Dave Freedman and many others I didn't see since I' was playing

Among the golfers were Bob Hanpeter, Jack Page, Tom Pawel, Eleanor and Harry Ottobrini, Em Callahan, Bill Moser and his wife. Lunch was a hamburger barbecue which I enjoyed while chatting with John Weil and his wife and Laurel and Ellis Barron.

The kids went out on a deep-sea fishing boat and buses took swimmers to the Manchester beach. The orchestra arrived at 5 PM and played while we enjoyed a New England clambake including clams, corn, fish, chicken and a complete lobster for everyone. Leon LaFreniere, who arranged the numerous excellent meals for the entire Reunion weekend, had selected a system of issuing a paper ticket to be exchanged for the lobster. Leon was surrounded with people as he issued the tickets.

There was dancing after dinner in a tent over the patio. This overlooked the golf course while the sun settled below the horizon. Among the many dancers were Pauline and Norb Andres, Zelda and John Walch, Nancy and Bill Zimmerman, Tel and Bob Sandman, Mariagnes and George Clifford, Nancy and Don Noble, Imogene and Jack Page, Gloria and Sonny Monosson and yours truly.

The buses took us back to McCormick Hall on the M.I.T. campus where we were staying during the Reunion. McCormick's dining room was used from 10 PM to 2 PM to provide drinks and refreshments while classmates relaxed and chatted in the beautiful living rooms.

Saturday morning we heard an exciting presentation by Professor John Donovan, about the computer course that he offers to undergraduates. At lunch President Wiesner joined us at Walker Memorial with about a dozen members of the faculty including Professors Bryant, Hartley, Wood, Douglass, Thomas, Sandy Brown, Morse, Mann, Wildes Mehringer, Rosenblith, Edgerton, and Hamilton. In a brief ceremony after lunch the class of '48 presented Mrs. Wiesner with an honorary membership in our Class.

On campus with us on Saturday were the alumnae of M.I.T. who celebrated the 100th anniversary of women at M.I.T. with a thoughtful program to which our class was invited. A number of our classmates and their wives attended the A.M.I.T.A. program.

At 5 PM the Class was the guest of President and Mrs. Wiesner at the President's house on Memorial Drive for

cocktails.

The class banquet was held in the Stratton Student Center on Saturday evening. Bob Mott and Bill Katz were the M.C.'s and Dave Doonan's orchestra played music for dancing. The orchestra was as excellent as they had been a day earlier at the Essex County Club. . Bob introduced Ken Brock who reported that the nominating committee had recruited a slate of class officers for the next five years. Without a single nomination from the floor or one dissenting

vote, the following classmates were elected: President, Dick Harris; Area Vice Presidents, Nick Caldwell; Bob Wofsey, Norm Kreisman, George Wayne, Mitch Silverstein, Jack Page, Bill Zimmerman; Secretary, Marty Billett; Assistant Secretaries, Leon LaFreniere and Bob Sandman; Treasurer, Graham Sterling; and Class Agent, Denny McNear.

Bob also introduced **Dave Freedman** and **Herb Lipson** who presented the sports awards. Although several awards were presented I wasn't able to record them for one reason or another, but I do remember that **Bill Zimmerman** received the tennis award. . . Bob and Bill conducted an auction of souvenir items that remained from earlier reunions. The bidding was active and everyone had some fun in the auction atmosphere that was created.

This year's souvenir was handcrafted by Dave Finnegan. Dave made a mold of the beaver on the gold mace that M.I.T. uses in academic processions. He molded replicas and mounted the beaver on a marble base with an appropriate plaque and an M.I.T. seal. Every alumnus who attended the Reunion received a

beaver.

The money received from the sale of ashtrays was the first income for **Graham Sterling**, as our Class Treasurer. After the auction, the band played music for dancing until the Sunday blue law required them to stop playing. The dance floor in the Student Center is quite large, and it was filled with classmates.

Back at McCormick Hall Bob Peterson started a putting contest in the entrance hall. It was early Sunday morning before everyone was asleep. . . I will write more about Sunday and Monday's events in the next column. (Don't miss the next chapter of your Notes).

The last day of Reunion was held in conjunction with the 40th, 50th, and other reunioning classes. At lunch in Rockwell Cage the assembled alumni heard President Wiesner report on M.I.T. Jerry also accepted gifts from the 25th, 40th, and 50th year classes. The Class of '48 presented the third largest class gift. Before introducing Jack Page, who is the chairman of '48's Reunion Gift Committee, Jerry reported that the day before Jack had shot his first hole-inone at the Wellesley Country Club. Jack, Tom Pawel, Harry Ottobrini, and the pro at the Club were playing the course when Jack hit a ball that didn't look too good. As it turned out looks aren't everything, because the ball went into the cup for a hole-in-one. Congratulations, Jack, for great golf and for fantastic fund raising at a time when a falling stock market made your job most difficult. Jerry accepted for M.I.T. a gift of \$597,560 from our Class. There were 678 donors who made the gift possible. Jack had the help of a reunion gift committee who also deserve thanks.

The Class of '48 demonstrated its support of M.I.T. with a tangible gift, but it also supported M.I.T. in less tangible but equally significant ways during the exchanges between us and representatives of M.I.T. that occurred during our Reunion.—S. Martin Billett, Secretary, 16 Greenwood Ave., Barrington, R.I.









One of the more official events of the Class of 1948's 25th Reunion was the presentation (top photo) of the Class Reunion Gift to President Wiesner by Gift Committee Chairman Jack Page. At center left, Sonny Monosson and Ted Yoos survey the lineup of reunion souvenir beavers handcrafted by classmate Dave Finnegan; and at center right,

classmates luncheon with Professor Walter Rosenblith. The bottom photo gives us a glimpse of the more "unofficial" side of reunioning as classmates and guests stretch out to enjoy a bit of sunshine on the lawn of the Essex Country Club. (Photos: Susan Pogany and Roger Goldstein) After a shortage of news in the last issue, we have a surfeit this month headed by news of the Reunion Committee and the 1949 Visiting Professorship Committee.

The Reunion Committee has been working actively with scheduled meetings on July 19, August 23, and September 13. The general plan for the reunion is now established: There be two distinct parts to the class gettogether. First part will consist of four days on campus, starting Saturday, June 1, 1974 and ending Tuesday night, June 4. Detailed program plans are now being prepared under the chairmanship of Paul Weamer. The second part, for those wishing to continue on a longer, more relaxing vacation, will consist of seven days at the Club Mediterranee in Ft. Royal in Guadaloupe, with round-trip charter transportation from Logan leaving Wednesday, June 5, and returning on Wednesday, June 13. The all-in price for the seven days will be \$154 per person. This includes all meals (with wine) and all sports and other activities. The only extra cost will be for hard liquor (with per drink costs substantially less than \$1). Transportation costs will depend on the number going. A full airplane will reduce the round-trip transportation costs to about \$90 per person. Children are welcome with special facilities and supervision to ensure that all the family can vacation. Since there is another reunion class who would like to join us for this junket, and since members of other classes will also be able to come if they wish, we have every reason to think that the minimum price will be achieved, making it a bargain too good to miss. All class members will receive complete details, probably near the end of the year. To confirm the trip, we will need \$50 per person deposits, probably by March 1, with a cancellation date for full refund no more than one month before scheduled departure date. Plan now to come. This is a once-in-a-lifetime opportunity and a suitable part of our one-and-only 25th Reunion. Chairmen for the Reunion Committees, in addition to Paul Weamer, are Jim Christopher, offshore program; Andy Bigus, souvenirs/gifts; Fletcher Eaton, registration; Ira Dyer, Institute liaison; and Harry Lambe, secretary/ treasurer. The chairmanship for the class statistics and class book (if any) is still

The Visiting Professorship Committee has also been active. Its second planning meeting was held August 4 "at the poolside of the Autumn Inn in Northampton." Its third meeting was Friday, September 14, in connection with the Alumni Officers' Conference. Len Newton will have more information for us in the next Technology Review.

As usual, we start off news of classmates with those items which come to us via Alumni Fund Envelopes. In alphabetical order, here they are: Bob Bigelow reports that he is now Assistant Chief Engineer for the New England Electric System in Westboro. He has recently

been appointed Director of Planning and Power Supply for the New England Power Pool and he is now a Fellow of the I.E.E.E. . G. J. (Gerald) Grott writes, "In 1968, while prospecting I quessed at the existence of an exceptionally deep basin under W. Phoenix. A wildcat hole discovered one of the world's largest bodies of continental salt-over a mile thick and about 30 cubic miles in volume. I have been busy ever since shoe-stringing a salt mine and an underground petroleum storage deal. Hope to see daylight soon. Meanwhile, back to the" bert S. Humphrey reports from London, "After three years of research here in England we have now developed a new process designed to improve communication between individuals in a group. The process permits a work party or committee to more effectively and quickly accomplish work, come to agreement, authorize and control subsequent work. There are important side effects. The system, called PARTICIPATIVE PLAN-NING, eliminates employee confrontations, reduces organisational frictions and builds morale. Productivity increases are measurable."

William Hutchinson reminisces as a result of reading a biography of his wartime commander: "Our generation has endured a lot of violence considering that we were born in a world that had just been made safe for democracy." . . . R. C. Peterson notes, "Eldest son Jeffrey is in the Class of '76 at M.I.T. and second son is making sounds about going to Tech in '74. Yikes! After eleven and a half years in Iran, we are in the midst of negotiations between the oil consortium and Iran. Still don't know if we will stay or leave. I may soon be job hunting again." . . . Al Levingston re-ports three positions: Vice President, Tax Sheltered Programs Inc. (Pension and Profit Sharing Advisors); President, Pro-fessional Staff Corporation (Leasing Staff to Professionals); Secretary/Treasurer, Long Securities Corporation (N.A.S.D., Seat on Boston Exchange). . . . Austin Marx "Was visited by classmate Ed Kerwin and reminisced over dinner in San Francisco about our 1950 bike trip to Belgium (being mistaken for two Dutch boys and staying in monasteries), i went back to Greece and the beautiful Aegean Islands last summer. Also last year I was President of the local San Francisco Peninsula Alumnus Chapter Tau Beta Pi." . . . From Chester M. Peterson, Jr., "In December will have been in Costa Rica 20 years. About six M.I.T. graduates here; I see them from time to time and we have gotten together. My own business is the sale, installation and service of machinery: boilers, sugar mill equipment, waterworks, textile machinery; also have an important chemicals and raw materials department. Staff includes three engineers (besides myself) and a chemist. The road has been hard, but would not change my decision to emigrate. Very happy here. One son at Georgetown, one daughter University of Costa Rica, one son in high school here. Spend weekends sailing on 30-foot sloop."

At Alumni Day this year, 26 classmates, wives and visitors registered and represented all the rest of us.

Dr. Ira Dyer, Professor and Head of the Department of Ocean Engineering at M.I.T., and a widely known authority on acoustics and related underwater phenomena, was named to the additional post of Director of the M.I.T. Sea Grant Program on July 1. Those of you who recall that M.I.T. is a "land grant" institution will understand the basic thrust of the Sea Grant Program which sponsors a wide spectrum of educational, research, and advisory projects and services which are concerned with the marine problems of the New England region at large. . . . Rear Admiral Merton Dick Van Orden, U.S.N., assumed the position as Chief of Naval Research on May 31, 1973. Another step upward in a long and successful career. Among his many other qualifications, he is a qualified scuba diver and has participated in several scientific dives. He is also the author of an illustrated book for youth, The Book of United States Ships. . . . Paul Weamer is now on the Board of Directors of the M.I.T. Club of Boston for 1973 and 1974. . . Fletcher Eaton, Principal Engineer in the Engineering Quality and Reliability Department of the Polaroid Corp., is now on the Executive Committee of the Engineering Societies of New England.

Dave Israel recently returned to visit MITRE (the Bedford operations) and gave a talk entitled, "Ten Plus Ten More Rules of Thumb" or "Systems Engineering Can Be Easy If You're All Thumbs." . . . William Haddon, Jr., is back in the news announcing Insurance Institute test-series findings which demonstrated the danger of current fuel tanks in standard American and imported automobiles. The Institute demonstrated that nearly every moderate-speed rear-end collision involves substantial risk of fire, even more dangerous since many cars suffered jammed doors in these same collisions. On that cheerful note, we will leave you until next month.

Best wishes to all classmates. Give to the '49 Visiting Professorship Fund and come to our 25th Reunion. See you there.—Frank T. Hulswit, Secretary, 35 Acorn Park, Cambridge, Mass. 02140

On June 4, 1973, Jim Cass Joined the James C. Buckley, Inc. Transportation Consultants in Washington, D.C., as Associate. He is responsible for Ports and Harbors work.

Hans Joerg Stern continues as Manager of General Electric's fluidics operation in Schenectady, which is developing and manufacturing industrial air gaging equipment and fluidic controls for aerospace applications. He was recently elected to the Board of Education of the Niskayuna Central Schools. This and his recently acquired hobby of flying will keep his spare time on the negative side. His wife, Mary, is kept more than busy with their children-Gail-married (B-MIT Christopher (13); Karen (6).

Professor John H. Schmertmann reports that his entire family (wife, Pauline; three boys, ages 13, 12, 10; and one girl, age 4) just finished a year in Ottawa, Canada. John was on sabbatical from his professorship at the University of Florida, Department of Civil and Coastal Engineering, and worked with the Canadian National Research Council, Division of Building Research, Geotechnical Section. He also received Norman Medal in 1971, which is the highest A.S.C.E. National

Award for a technical paper.

After four years in Europe with Reynolds International, Charles A. Herbert has returned to the San Francisco Bay area to head manufacturing operations of Optical Sciences Group, Inc., in San Rafael. Charles lives in San Rafael with his wife, Betty, and daughter, Barbara. . . . After 15 years of growth with his present company, the last seven as Vice President, and the last four as Vice President and Director of an international corporation, Bob Furman is seeking a new challenge. Having set up manufacturing and sales subsidiary companies in Argentina, Brazil, and Japan, Bob feels he can help companies to market internationally. . . . Having retired from 20 years of active duty with U.S. Air Force, Robert Geiss is presently employed with Rockwell International Corp., Autonetics Division, Anaheim, Calif.

William L. Clemons recently received his master of divinity degree from Gordon Cornwell Theology Seminary. He was a lieutenant in the army and was employed at Gruman Aircraft until he moved back to Massachusetts and was employed for a time with Texas Instruments of Foxboro. While studying for his master's, he was consulting engineer at Beth Israel Hospital in Boston. Bill is married to the former Edith D'Amato. They have two children, David, and Mrs. Gregory Torres, both of Brockton. . . . John J. Earshen recently met Don Bishop and his daughter at R.P.I. John was accompanied by his son. Both youngsters are considering attending R.P.I. in a premedical program.

Among the alumni day attendees for the Class of 1950 were Mr. and Mrs. Rex L. Anderson; Mr. and Mrs. Robert E. Erickson; Mr. and Mrs. John T. McKenna; Mr. and Mrs. Louis Mager; Mr. and Mrs. Robert W. Mann; Mr. and Mrs. Warren Marcus; Mr. and Mrs. Robert C. Michel; Mr. and Mrs. Robert Snedeker; Mr. and Mrs. Walter I. Wells.

The Brysons (Allen and Dorothy, and daughters Judy (18), Janet (14), Lesley (11), and Laurel (7), moved to Arcadia, Los Angeles, last September, when Atlantic Richfield transferred corporate and some division headquarters to new fiftytwo story twin tower Atlantic Richfield Company plaza. Allen is presently manager coordination and evaluation products division. Daughter, Judy, to enter Westmont College at Santa Barbara in September. . . . Charles J. Lucy has been appointed manager of the Telecommunication Products Department at Corning Glass Works in New York. He joined Corning in 1952 as a research engineer and subsequently served in various positions until his present promotion.

Joseph D. D'Annunzio, President of D'Annunzio Brothers in Scotch Plains, N.J., has been named "Ditch Digger of the Year" by the National Utility Contractors Association. He served as the association's third president in 1969 and 1970 and was cited for his contributions to the

association and industry for his efforts to upgrade and professionalize the image of the utility contractor. Following graduation from M.I.T., Joe was party chief on a North African Airfield Construction project and worked for several leading New Jersey construction firms before joining his family business in 1957. He assumed the presidency of D'Annunzio Brothers in 1963. He is also active in a number of community and professional organizations including the American Society of Civil Engineers, the American Water Works Association, and the New Jersey Water Pollution Control Association. He is a director of the Franklin State Bank of Somerset, N.J. Mr. D'Annunzio resides in Scotch Plains with his wife, Viola, and their seven children. . . . Victor E. Saulnier informs us that he is now a dentist. (McGill 1966)

We regret to inform you of the sudden death of Leonard H. Caro on May 15. Mr. Caro was involved in numerous community affairs and at the time of his death he held the position of City Manager in Wheaton, III. He received the following recognition during his career: 1950-M.I.T. member Chi Epsilon, honorary civil engineering society; 1966-Bradley member Tau Beta Pi, engineering achievement society; 1966-Good Government Award by the Peoria Jaycees; 1970-Outstanding Service to Profession, Peoria professional engineers: 1970-Distinguished Community Service Citation by Peoria City Beautiful. He leaves his wife and four children.

Donald P. Germeraad reports that he is presently the Assistant Program Manager, surface effect ship program at Lockheed Missiles and Space Company in Sunnyvale, Calif. . . . This year, Mr. and Mrs. Richard L. Bolin attended the 25th anniversary of the M.I.T. Club in Mexico City.

Dr. John H. Litchfield is among 70 inventors who were honored recently (June 19) for patents they received during 1972 as staff members of the Columbus Laboratories of Battelle Memorial Institute. He was honored at the first of an annual series of invention award programs planned Battelle Development Corp., in recognition of inventors at Battelle's research laboratories. Dr. Litchfield received two patents related to the development of anticavity agents for chewing gum. His home is in Worthington, Oh.—John T. McKenna, Secretary, 2 Francis Kelley Rd., Bedford, Ma. 01730

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From the currently popular World of Environment we hear about James P. Friend who has been promoted to Professor of Atmospheric Chemistry, New York University, Department of Meteorology and Oceanography... John W. Wright, physicist for the Naval Research Laboratory, has been researching microwave and radar systems and techniques for gaining a better understanding of the ocean environment. He presented a paper on "Radar Backscatter from the Sea" to the International Conference on Engineering in the Ocean. . . Then there is Ed Stringham on the Advisory Group for

American Public Works Association studying pollution related problems. He has also been elected Trustee of Keuka Col-

lege, Keuka, N.Y.

Edwin T. Richard is President of Computer Image Corp., which has developed a new family of computers for generating moving visual images and transferring them onto film or videotape. Their facilities are located in New York, Denver and Hollywood. . . . Nicholas Browne, industrial engineer, has moved from Union Carbide to Culligan of Kansas City. . Serving as Director of Community Development Program for the City of Cambridge, Mass., is Edward A. Handy. . . . Melvin R. Rubin is on the staff of the Dynamics Section of the Structures Department at Raytheon Missile Systems Division, Lexington, Mass. . . . William R. Freeman, Jr., is now Vice President and Technical Director for Superalloy Group of Howmet Corp., in Greenwich, Conn.

From Detroit, Peter C. Darin, Jr., has moved up to Executive Vice President of Darin and Armstrong, Inc., one of the nation's oldest and largest contractors. He has been with this firm since 1953 with the exception of brief interruptions for work with General Motors Corporation's Argonaut Realty Division and heading up the Housing Task Force organized by New Detroit, Inc. Peter is a founder and currently president of Kensington Academy, an independent boys school in Bloomfield Hills, Mich. . . . Daniel D. Sullivan, architect and developer in St. John, Virgin Islands and Cape Cod, does a lot of commuting which includes England where he has a son attending school. Another son attends a school in St. Thomas. Daniel writes "Latest multisensual experience is St. John Square, a small intown urban revitalization incorporating shops, offices and courtyards in beautiful downtown Cruz Bay."

Myron Lecar, astrophysicist at the Smithsonian Astrophysical Observatory, has been involved in three-year project of constructing first astronomical observatory in Israel. He is now working on a theory that asteroids are leftover "building blocks" of the solar system Clark C. Abt of Abt Associates, a recognized leader of educational technology, is exploring the possibilities of introducing new technological methods of teaching in Europe. In preference to programmed textbooks, teaching machines and language laboratories, he sees possibilities of inexpensive synchronized 8mm cameras, miniature video cassettes and players, and miniature photocopying machines which will allow students or businessmen to record seminars and lectures for private storage.

Emily L. Wick has been awarded a Bronze Beaver. The citation reads "In your progression through M.I.T. as student, teacher, dean, friend and mentor to women students at M.I.T., you have made a unique contribution to the life of the Institute. You have been advocate and model for a generation of women students at M.I.T. from a handful to an abiding presence. Your contributions to the growth and spirit of women at M.I.T., have left a lasting mark on the Institute."

. . Herbert B. Voelcker, a professor at the University of Rochester, N.Y., was

recently elected a Fellow of the Institute of Electrical and Electronics Engineering and was honored for "contributions to modulation theory and digital signal processing, and for teaching of electrical engineering." He is director of the College of Engineering and Applied Science's Production Automation Project. In col-Gleason Works laboration with Rochester, his project is designed to develop improved efficiency in small and medium scale discrete manufacturing processes.-Fred W. Weitz, Secretary, 4800 S. W. 74th St., Des Moines, Ia., 50321; Samuel Rubinovitz, Assistant Secretary, 3 Bowser Rd., Lexington, Ma. 02173; John Dowds, Assistant Secretary, 1800 N. W. 18th St., Oklahoma City, Okla. 73106; Marshall Alper, Assistant Secretary, 1130 Coronet Ave., Pasadena, Calif. 91107

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News from the Class has mounted substantially in the last month. A large backlog of news is the best possible situation for a Class Secretary. Captain Charles J. Mathews writes that he was promoted to the rank of Captain Civil Engineering Corp., U.S. Navy in November, 1972 and he is now assigned as Force Civil Engineer on the staff of Commander Naval Air Force Pacific Fleet in San Diego, Calif. . . . An Air Force press release reports that Norman E. Niederman has been promoted to Colonel U.S. Air Force. Norm is Chief of the financial resources management division at the Los Angeles Air Force Station in Calif. He is assigned to the Space and Missile Systems Organization. . . Our past Secretary, Dana Ferguson, has written me a card from Kenya. Dana says that he has been on a trip via Rio through the Republic of South Africa, Kenya, Tanzania, and will return home through Greece and Britain. We all wish we were bachelors and could follow Dana on his travels. Some of us are much too tied down by family and other activities. . . . Richard H. Daly writes that this past year, in addition to his career as a section manager at Raytheon, he has been Chairman of the Framingham, Mass., school committee. Dick also writes that his family has increased to seven children with the birth of Kristin in March.

Ed Margulies writes that he and Paulette now have a son, Daniel Gordon, born February 15, 1973. . . . Robert W. Trenn is now an investment officer with the Harris Trust in Chicago. He writes that he is living the full suburban life with his wife and seven children and associated household pets. (No trip to Africa via Rio!). . . . A few overseas' reports: B. R. Groves writes that he is Dean of Engineering and Applied Science at the Gippsland Institute of Advanced Education, Churchill, Victoria, Australia. Gippsland Institute is one of ten institutions in Victoria that train about 60 per cent of the engineers in Australia. There are 500 students in the school with programs in electronics, mechanical engineering, civil engineering, and chemistry. . . From England, Swaraj Paul reports that he has two twin boys age 15 attending Harrow School, a girl age 13 at Roedeau School, Brighton and a two-year old son. Swaraj is in the business of steel manufacturing in India, operating a shipping line and financing.

The Regional Manager, Westinghouse Elevator Division-marketing, construction and maintenance of Westinghouse elevators and electric stairways in France is Alexandre Maidanatz. . . . Two new California residents are Robert A. Naber, M.D. and Clifford H. Morse. Dr. Naber writes that he has no family yet and that he has just headed to Estes Park for a general practice conference. . . . Cliff Morse recently left the Architects Collaborative in Cambridge and joined the firm of John Carl Warnecke and Associates in San Francisco. He is now managing the architectural work on the new government center towers in Minneapolis. . . . Jim Margolis has sent a note saying that he recently completed two important world studies on the energy crisis and environment problems: ("Petroleum vs. Coal: World Report" and "Nuclear Reactor Power Plants: World Outlook"). . . . Ralph C. Stahman spent two weeks in Russia in March participating for the Environmental Protections Agency in the U.S.-U.S.S.R. technology exchange program on air pollution control. . . . Leon M. Polinski is now a Senior Chemical Engineering Research Supervisor at Englehard Minerals and Chemical Corp. Leon is responsible for guiding the preparation of catalysts for anti-pollution proc-esses and systems. He was elected Director of the Catalysis Society of New York for 1973-4.

Martin R. Fink is Senior Consulting Engineer, Aerodynamics at United Aircraft Research Labs. Last year he became an Associate Fellow of the American Institute of Aeronautics and Astronautics; this year, President of the Central Connecticut Alumni Chapter of Tau Beta Pi. . . George A. Skiadaressis has been teaching and consulting on the faculty of School of Architecture, University of Maryland since 1970. . . . Burton Green writes that he is President of the Burton Green Corp., specializing in hospital electrical safety, contract testing and record keeping, staff training, and sales representation for safety test equipment. Burt also works as a general contractor at home repairs, especially electrical and electronic systems including antenna, intercom and music systems. . . . Roger R. Borden is Assistant Professor of Mechanical Engineering at Worcester Polytech Institute and was ordained a Deacon in the United Methodist Church in June 1972. Roger is serving a part-time ministry in the Charlton City United Methodist Church. . . . Tim Brown writes that he is still working at the Manned Spacecraft Center in Houston where things are beginning to move on the space shuttle program. During Xmas, he, his wife Bunny and his three children, Mike, Murphy and Sherry, are planning to take a Caribbean cruise on the Song of Norway out of Miami.

Clifford M. Sayre has returned to Wilmington, Del. after six years on the Gulf Coast in Texas and Louisiana. He has returned as Business and Financial Analysis Manager of the Polymer Intermediates Department at duPont after 20 years in research and development and manufacturing. Cliff writes that his son. Frank, is now a senior in classics at the University of Texas in Austin. . . . Jim Davidson is now in business as James W. Davidson Co., Inc., Management Consultants for Executive Recruitment and Catalyst Programs in New York City. . . . Doug Haven is now associated with Trend Financial Inc. in Cambridge, Mass. . . . And now, a list of promotions: Nathan Sivin has been named to the rank of Professor in the M.I.T. Department of Humanities. Professor Sivin has taught history at M.I.T. since 1966.

Dr. Herman H. Smotrich has been named Vice President, measurements technology and systems, (M.T.S.) of A.V.C.O. Everett Research Lab., M.T.S. is responsible for an observatory on the island of Maui in the Hawaiian islands as well as two specially equipped aircraft used in monitoring I.C.B.M. tests in the Atlantic and Pacific. Dr. Smotrich's organization is actively involved in the analysis and synthesis of field measurement systems involving active and passive optical technology. Prior to joining A.V.C.O., Dr. Smotrich was associated with the U.S.A.F. Research and Development Directorate at Kirtland Air Force Base, New Mexico, where he participated in the Air Force's high altitude sounding rocket programs. Also at Kirtland, he participated in their early A.I.C.B.M. studies. He resides in Andover, Mass., with his wife Carolyn, one son, and one daughter. . . Arthur S. Turner has been named Vice President of the Spectrochemical Division of Baird-Atomic, Inc. in Bedford, Mass.—Richard F. Lacev. Assistant Secretary, 2340 Cowper Street, Palo Alto, Ca. 94301. . . Arthur S. Turner, Secretary, 175 Lowell St., Carlisle, Mass. 01741

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And a Happy Halloween to you too. Go easy on the warm cider. Everett Chambers recently completed a C-5 giant jet transoceanic flight. Ev, a Lieutenant Colonel in the U.S.A.F., piloted the flight that demonstrated for the first time in a single mission the jet's capabilities for low altitude air-drop, aerial refueling and transoceanic flight. Now Ev, if you can sweep over the mid-Western states and scoop up some beef, for a drop around Carlisle or Westwood. . . . Bill Gleckman won the 1972 Building Owners and Managers Award. This was for Urban Residential Apartment Renovation. Bill also won the 1971 N.Y. Chapter A.I.A. Residential Design Award. Bill continues his practice of architecture in N.Y.C.

Fred Holmes is Chairman of the University of Western Ontario's Department of Medicine and Science. He previously taught History of Science at Yale and is publishing a book on Claude Bernard, a 19th century physiologist. Fred and Harriet's three children are Catherine 12, Susan 10, and Rebecca 7. . . Dean Jacoby is Chairman of the Community Chest Budget Committee in Concord, Mass. Dean expects to sever his long career with M.I.T. shortly after Labor Day in order to enter industry. For one who

loved the Institute and everything it represented, this move should be a real loss to M.I.T. Best wishes in your new ventures Dean! . . . Jack Maier has joined Thermo-Lab Instruments Inc., as Executive Vice President. It is a small but rapidly growing company manufacturing and selling automatic instrumentation for oxygen measurement. Applications for this type equipment include combustion control and pollution control. The company is located in Glenshaw Penn., for those in the area who would like to congratulate Jack.

Leroy Malouf is Director of the Organization and Management Dynamics Division as a newly appointed Vice President of Rath and Strong, a Lexington based management consultant firm with offices in Chicago and San Francisco. . . . Hugh Nutley received a Ph.D. in physics from the University of Washington in 1960. picked up a B.A. in English-with an emphasis in writing, at the same school this past March, and is currently working on an M.A. in English-advanced writing, which he expects to complete by next August. Hugh has signed a contract with two others to write a book on science fiction for Holt, Winston, and Rhinehart. Talk about changing careers when one hits his forties! From our discussions with classmates, this phenomena is fairly prevalent, at least in the desire stage. Congratulations Hugh on having the drive to go after your goals. . . . Hugh reports seeing Stewart Smith at an M.I.T. dinner. Stew is Chairman of the Geophysics Department at the U. of Washington and was active in the dedication of a new three million dollar geophysics building there.

Armando Santa Cruz attended the 25th anniversary of the M.I.T. club of Mexico City. We hear it is a great take. For Armando it is just a drive around the block but we are proud that our classmate had

the interest.

Alumni Day attendees included Paul Gray, Mickey Sama, George Schwenk and their wives. Dick Morley also attended this happy occasion. . . Art Sargent has been promoted to Lieutenant Colonel in the U.S.A.F. He is Chief of T-39 jet section at Langley A.F.B., Virginia. Art holds the rating of command pilot. . . Perry Smoot is working on processes for fabricating compressor rotors for turbine engines. He enjoys life in Wayland, Mass., including kayaking on Lake Cochituate. A kayack is less stable than a canoe, but we hear that the big Carling brewery there has an overflow pipe into the lake.

Received a nice letter from Harry Taylor who is in Israel playing host to a horde of tourists and who laments that so few of you are among that horde. Vanda has a chance to show off her good cooking. The speciality of the month last month was Chinese food. Harry has been pleasantly surprised by the American Institute of Aeronautics and Astronautics who named him an Associate Fellow. . . . John Zarcaro was awarded the N.A.S.A. Exceptional Service Medal in recognition of his outstanding contributions to the APOLLO program. John, now Deputy Manager of the Earth Resources Program Office at NASA's Johnson Space Center, has played an important part in all of the manned space programs. John now lines in Seabrook, Texas, about 30 miles southeast of Houston. John married Rose Veronica Gonzalez of New Orleans and their children are John 15, Michael 13, Rose Ann 10, and Anthony 7. John, any news on our missing person, Mike Boylan?

A letter received from Jerry Cohen just before deadline inquired about our quinquennial revel. Calls to Bob Warshawer, our class president, and Harvey Steinberg our reunion chairman have gone unanswered. We expect that they have made commitments, in all our names, to go somewhere, at some time. If and when we get some information, we will be happy to pass it along.—Dave Howes, Box 68, Carlisle, Mass. 10741; Chuck Masison, 76 Spellman Rd., Westwood, Mass. 02090

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Not everyone neglects their class news column. I received a letter from **Bud Sadoff** that is interesting and informative, and that should set an example for the rest of you. "Dear Allan: Noting your complaint about lack of mail, I decided to write because I am, God willing, going to celebrate my fortieth birthday in three days, and, although this is happening to most every other guy in the Class of '55 this year, it seems like an appropriate time to tell the world of M.I.T. about what has happened to some of us who have become neither rich nor famous.

"I live in Rockville, Maryland (Suburban Washington, D.C.) with my first and only wife, Sandra, two beautiful and talented children (Carol is 16 and B. J. III is 11) in a large house with a very large mortgage, with a large dog who eats a lot. I mention all of this first, because it is the most successful aspect of my life thus far, since Sandra and I are not contemplating divorce (as far as I know), the kids are well behaved and not on sex or drugs (as far as I can determine) and the dog is very well adjusted. I have never been sued, the service charges on my overdue bills have never exceeded \$10.00 per year, none of us has ever been under psychiatric care, and neither the Select Senate Committee nor the Watergate Grand Jury have been interested in my testimony.

"I am the Vice President and a Director of Pressure Science Inc., a manufacturer of metallic seals and ducting joints. I have been with this concern for five years (the longest time in one job since graduation) and we have grown by a factor of four during that time. This may sound like a big deal, except that we started from such a small base that you could still put our whole operation into a little corner of any one of our customer's plants and never notice that it was there.

"All of the things that we make are designed by us (not me, but us, meaning the founder of the company and two other mechanical engineers and me), much of it on equipment and tooling that we have designed and built. Our products are in all of the current generation of aircraft (747, DC 10, L-1011, Concorde, F-14, F-15, B-1, F-16, F-17 etc.) as well as

in some nuclear and industrial equipment both in the U.S. and abroad.

"In this day and age of super-government, multi-national corporations, and immense institutions, it is, in my view, semimiraculous that a privately held corporation employing about 70 people can, without benefit of government or foundation research grants, develop, manufacture, and market products at a profit. I really do not know how many of our classmates are still trying to make a buck this way, but those who are will know what I mean. It sometimes seems that I should give up and join the army of my neighbors and classmates who write the regulations, rather than be one of the few who must read, understand, and try, under penalty of law, to comply with them. Actually, I know that I will stick it out to the bitter end, however, because it is just too damn much fun trying to stay alive.

"I was going to include some notes about my M.I.T. classmates that I never see mentioned in the Class Notes, but, on further reflection, I think that this would be too presumptuous. If they want to see their names in your Notes, then I guess that they know where to reach you. Most of them are struggling along, trying to make a buck, have some fun and excitement, do something significant, and keep their sanity and families together. Two that I know of are dead, one by his own hand, and many are trying to make it with a second wife. The most courageous that I know just fathered a newborn, with two ready for high school and his oldest about to go to college. Perhaps on my eightieth birthday I will understand what it is all about, and be ready to name names and explain it all in the Class of '55 Notes for the edification of the Class of 2015. Best regards, Bud."-Allan C. Schell, Secretary, 19 Wedgemere Ave., Winchester, Mass. 01890

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Dr. James Bjorken has been elected to membership in the National Academy of Sciences. He is Professor of Physics, Stanford University Linear Accelerator Center. . . Dr. Forbes Brown has received tenure at the rank of Professor in the Department of Mechanical Engineering and Mechanics at Lehigh University. He is a specialist in analysis and control of dynamic systems. In addition to research, writing and consulting in his field, he is past Chairman and currently a member of the executive committee of the fluids engineering division, American Society of Mechanical Engineers, an associate editor-at-large of the "Journal of Fluids Engineering" and "American Society of Mechanical Engineers Transactions", and serves as Technical Advisor to three additional publications. . . Pete Calcaterra has been named Personnel Manager for Bose Corp. He, Anne, and their four children live in Arlington.

... Jake Gubbay was recently appointed Staff Materials Engineer, Honeywell Radiation Division, Lexington, Mass. Visiting from California was Margaret Hughes Young, who has started a company that manufactures mountain climbing equip-

ment. . . . Bill Peter, Jr., whose office is in the Empire State Building, is Marketing Manager of hosiery for duPont.

Attending the celebration of the 100th anniversary of women graduates was Marilyn Schranze Gulotta and husband Charles. Now that their daughter is seven, Marilyn is planning to resume work in computer programming. Dr. Aaron Temkin has been selected a fellow of the American Physical Society. He is head of the theoretical studies branch of the N.A.S.A. Space Flight Center in Maryland.-Cosecretaries: Bruce B. Bredehoft, 3 Knollwood Dr., Dover, Mass. 02030; Mrs. Lloyd Gilson, 35 Partridge Road, Lexington, Mass. 02173

Here we go with another volume of Technology Review. Any of you who are in Switzerland this winter can look up Ron Enstrom. Ron dropped us the following note: "R.C.A. Laboratories has awarded me a European Study Fellowship and I have decided to spend the sabbatical year (September '73-September '74) at the E.T.H. in Zürich, Switzerland. It should be a memorable experience for all of us." . . . Mike Brenner advises us that he is now an Executive Vice President of Anthony Kane, Inc., coping with profit and loss responsibility. He adds, "We are a national executive placement firm specializing in financial types." . . . Stan Kroder is with I.B.M. as Manager of Federal Industry Education. He and his wife Sandy and three children have moved from Alexandria, Va., to Gaithersburg, Md. . . . Hans Hennecke has moved into a new position with the Air Force Avionics Laboratory, Electronic Technology Division, Advanced Devices Branch. His responsibilities involve management of Research and Development programs-both in-house and contractual-in the area of nuclear radiation effects on electronics and development of radiation hardened electronics. . . . Alexander Bernhard is now a junior partner in the law firm of Hale and Dorr in Bos-

Members of the Class who attended the Alumni Day festivities in June included Jim Cunningham, John Currie, Bill Doughty, John Eisenmann, Terrence McMahon, and John Spencer. . . . Dominich Fortunato sent us the following news: "My family and I have just recently moved into our first house in Park Ridge, N.J. My company, Burns and Roe, has the contract to provide architect-engineer services for the Liquid Metal Fast Breeder Reactor demonstration plant. I have been assigned as Supervisor of Materials and Standards for this project." . . . The last tidbit for the month is about

Bruce Grover. Bruce is now Executive Vice President of Vinyl Plastics Inc., Sheboygan, Wis.-Fred L. Morefield, Secretary, c/o Mobil Oil Caribe, Inc., P.O. Box X, Caparra Heights, Puerto Rico

again! Hope you had a super

vacation. For those of us who attended the 15th Reunion in Edgartown it was an extra vacation that was, by every report, sensational! The weather was warm and sunny all weekend, the food was excellent, enthusiasm and camaraderie abounded, and a good time had by all. Most of the 115 people arrived Friday night to have a full weekend of tennis, bicycle riding, swimming at the beach or around the pool, and meeting old friends. Making the scene were: Margaret and Arnie Amstutz, Mary and Ken Auer, Kay and Dick Barone, Barbara and Bill Bayer, Sharen and Jim Benenson, Ann and Dave Berg, Thelma and Dave Bold, Adeline and Al Brand, Cynthia and Mike Brose, Pat and Jack Conner, Teddi and Alan Curtiss, Barbara and Mark D'Andrea, Bebe and Gary Fallick, Roberta and Fred Fisher, Helen and Gus Fleischer and their children Cheryl and Linda, Maywood and Lou Giordano, Betty and Don Grieco, Tina and Steve Hadjiyannis, Ann and Neil Haller, Karolyn and Pete Hellsten, Pat and Dan Holland, Leta and Dick Hough, Maryanne and Bob Jones, Carol and Bob Lee, Dorothy and Joe LeVecchio, Chesley and Bob Logcher. Marguerite and Pete Lynch, Carol and Ed Macho, Joyce and Jim Mahaffy, Ann and Dick McCullough, Kathleen and Joe Meany, Anne and Tom Mills, Martin Needleman and Toni Schuman (Needleman), Ann and Ed Newton, Louise and Martin O'Donnell. Pete Peterson, Janet and Al Philippe, Carol and Conrad Revak, Elizabeth and Bob Ricci, Pat and Dick Rosenthal, Rona and Paul Rothschild, Carol and Willy Sander, Phyllis and Bob Schwartz, Ann and Roy Scarpato, Joyce and Louis Seigle, Dottie and Dick Shaffer, Margaret and Bob Soli, Arlene and Irving Stiglitz, Gail and Alan Storms, Kathie and Glenn Strehle, Kathleen and Ed Sullivan, Janice and Frank Tahmoush, Gail and Jason Taylor, Jane and Mary Tenney, Roy Thorpe, Judy and Dick Wick, and Linda and Gene Zuch.

In all, the Reunion was a great success and a special vote of thanks from the Class to Gary Fallick and his hard-working committee for their fine job. Everyone is looking forward to the next reunion and there are plans afoot for some "minireunions" on Alumni Day in the intervening years. We'll keep you posted.

In other news notes, Edwin Lee has started another company, Pro-Log Corp., which designs mini-computer based systems such as a heart monitoring systemtheir first product. Their firm is an engineering oriented company supplying services to other organizations ranging from design to pilot production. Daryl Wyckoff is a lecturer at Harvard Business School and writes that" we are very active backpackers in our spare time. Besides my teaching at Harvard, I am a consultant to government agencies, transportation associations, conglomerates and restaurant chains." . . . We have news that Bob Cooper has received an appointment as a Sloan Fellow this year. Bob has been with Avco Systems Division where his most recent post has been Manager, Advanced Operational Reentry Systems.-Michael E. Brose, Secretary, 30 Dartmouth St., Boston, Mass. 02116

Lieutenant Commander Dr. Michael R. Terry informs us he is back from a tour with the Naval Advisory Group in Saigon and is now attached to the Naval Ship Systems Command, Washington, D.C. His wife and daughter have joined him in Silver Spring, Md. . . . N. Barrie McLeod has been appointed Vice President, N.V.S. Corp., and transferred to Donedin, Fla., as Manager of the N.V.S. subsidiary, Southern Nuclear Engineering. Roger J. Sullivan began a new job in March of 1973 as Staff Scientist at System Planning Corp., in Arlington, Va. He and his wife and son reside in Arlington. three miles from S.P.C. and Roger keeps fit by bicycling to and from work. . . Charles A. Muntz is currently Director of Applications at Mass. Computer Associates, Inc., in Wakefield, Mass., and is actively involved in computer software, especially language and compiler design. . . Robert Edelson and wife Susan had a baby girl, Sara Elaine on June 10, 1972 at U.C.L.A. Medical Center. He is currently working at Jet Propulsion Lab on the Mariner, Venus, Mercury 1973 spacecraft mission operations.

Dr. Theodore P. Labuza is Professor of Food Science and Nutrition at the University of Minnesota. In 1972 he was awarded I.F.T. Research Award. He is also Visiting Professor-Mayo Clinic and on the M.I.T. Education Resources Council. . . . Jeremy R. Goldberg tells us that child raising is a major activity in the Goldberg household and that M.I.T. did not prepare them for this task, but they manage to cope with it. . . . Richard N. Sutton is now residing in the Columbus, Mo., area and would be interested in knowing if any other alumni are in the area. . . . Joseph Rapaport and his wife and guests attended the Alumni Day festivities. . . . Marco A. Murray-Lasso and his wife Nancy were hosts to the 25th Anniversary of the M.I.T. Club in Mexico. . . Also in attendance were Mr. James D. Miller and his wife Irene. . . . Dr. Warren M. Zapol received an appointment to the Faculty of Medicine at Harvard University and was promoted to Assistant

Professor of Anaesthesia.

David H. Bragdon informs us that he is the Director of Van School which is rather unique in that the school, covering grades 9-12, has two part-time and nine full-time students; one full-time and eight part-time teachers and offers a variety of courses that include Algebra, German, Folk Dancing, and Life Drawing. The school's name, "The Van", derives from its being a "minischool" which can and frequently does fit into a 12 passenger van. From the school's home base, Hancock, students regularly travel to many different places. In the spring term, students will take a course in computer programming at the Wang Laboratories, Tewksbury, Mass. Orientation to this course was given during two field trips to M.I.T. this past fall. . . . As a service to Alumni who may not have received their yearbooks, Technique will mail a postage prepaid copy of your graduating class's book for \$5 billed with the book. Interested parties may contact Susan Burk at





David H. Bragdon, '62, (at far left) is director of the rather unique Van School in Hancock, Mass. At the left some of the school's students (there are 11 in all, from grades 9 to 12) pile into the school's namesake, a 12-passenger van which transports the "minischool" on its outings. When back at its home base in Hancock, students can choose from a variety of subjects including algebra. folk dancing and life drawing.

M.I.T., Branch P.O. Box 5, Cambridge, Mass. 02139.-Gerald L. Katell, Secretary, 122 N. Maple Dr., Beverly Hills, Calif.

A weekend on Martha's Vineyard. Hotel overlooking the ocean-lighthouse on a sand spit-buckets of lobsters and steamers. Perhaps the heavy spring rains made New England particularly beautiful this year, or maybe my vision was colored on my first visit to the Bos-

ton area in five years.

The small group of us who attended the ten-year Reunion had an outstanding weekend. Excellent accommodations, food, and entertainment were arranged by Tom Gerrity and the Reunion Committee (including among others Ira Blumenthal, Kent Groninger, and Marty Schrage). Forty-four classmates and their families and guests participated in a program which featured a lobster and steamed clam cookout at the water's edge. Saturday afternoon was spent at the beach, and Saturday evening there was the traditional banquet, cocktail party, and dancing. For a few of us the evening ended with a 2 AM dip in the pool of the Harborview Hotel.

Class Agent Pete Van Aken served as toastmaster at the banquet. The initial order of business included the presentation of prestigious awards such as the Best Sunburn (to Cynthia Kolb Whitney) and the Long Distance Travel Award. (In spite of a strong California contingent-Larry Beckreck, Cal Culver, and myselfthis award went to Mike Sheriff, who came all the way from Libya.) The results of the class questionnaire always occupy a central place at reunion banquets. This year, however, you didn't receive that questionnaire because, in keeping with the times, the Class of '63 did a simulation of the questionnaire. Steve Swerling summarized this dubious bit of data processing. The following facts came out: Income—99 per cent of the Class earns between \$1 K and \$500 K annually. Sex to the question "With whom do you have sexual relations?" Fifty-three per cent responded "my spouse", 32 per cent responded "others", and 15 per cent responded "none of the above". Finally, it was noted that, in accordance with one of the great conservation laws, the total amount of hair in the Class had been conserved. However, the center of gravity of the hair mass had shifted downward from the cranium toward the upper lip

and lower jaw.

Class President Jim Champy spoke briefly for the outgoing administration (Vice President Steve Kaufman, Treasurer Swerling, and Agent Van Aken.) Outgoing Secretary Marty Schrage spoke briefly, as has been his habit over the last five years. New class officers were ramrodded into office in an election which continued our nation's finest political traditions. The new slate of officers included-President, Gary Stone, Vice President Steve Bernstein, Agent Tony Doepken, and yours truly as Secretary.

Being totally unprepared for my new responsibilities I was quick to recruit help from Georgie and Jim Hallock, and Ilsa and Jim Evans as corresponding Secretaries. Ilsa would like to hear from Class members who are living unusual lifestyles or pursuing unusual careers. Most M.I.T. alumni, judging from our own Reunion and reading about other classes, are engaged in business or technical jobs, and are living the conservative lifestyles we learned as children of the fifties. Let's hear from those of us who are breaking these patterns. Of course I hope to get occasional letters from the rest of the Class too.

About a month after the Reunion I discovered I had still another assistant in the person of Margaret Kelly, Alumni News Editor of Jechnology Review. Every month each Class Secretary receives an envelope from Margaret with the flaps from Alumni Fund contribution envelopes. Besides the news from current flaps, I now have on hand a good supply of old news-note flaps from the past year, and dating back to 1971. During the next year I'll dribble out this old news for as long as it lasts.

I'll close with more personal observations. My own trip to the Reunion included a brief stay in Boston and an afternoon at M.I.T. The Boston skyline has changed incredibly since our tenure at the Institute. Whereas the Hancock building and johnny-come-lately Prudential Tower used to dominate, they are now just a few among many tall buildings. The golden dome of the Massachusetts State House can be picked out only by the trained eye. The skyline at M.I.T. has changed too-there are many new buildings and virtually no interior parking lots. The latter are all peripheral lots and garages. Some things have remained constant too. You can get a feel for a place from its wall writing—posters, graf-fiti, etc.—and while the content has changed in ten years there is a certain M.I.T. style to this art form as it appears in Institute corridors and residence halls.

Drop me a line with notes, news, comments, or call if you're in the Los Angeles area.-Mike Bertin, Secretary, 18022 Gillman St., Irvine, Calif. 92664

This month has brought forth four Class Heros who have written me of their activities. One is Dough Hoylman, who is a Junior Actuary with Crum and Forster Insurance Companies in Morris Township, N.J. He has recently become an associate of the Casualty Actuarial Society. . . . John Meriwether has spent the last two winters in the frozen wilds of Alaska measuring upper atmosphere winds for the High Altitude Lab at the University of Michigan. He has now moved to the somewhat less frozen wilds of Boston to work for the Air Force Cambridge Lab. His wife Erika is working on her Ph.D. in botany at the University of Maryland, so John will be commuting on weekends. . . . Jim Monk reports that he has also moved back to Boston with Arthur D. Little in the Energy Economics Group. On his way back he stopped to visit Julian Adams in Virginia, who he says is selling cars and growing backyard vegetables to beat the high cost of living. . . . Len Parsons, Acting Chairman of the Department of Business Administration at Claremont Graduate School, is still another returning to Boston this fall. Len is a Visiting Scholar at M.I.T.'s Sloan School of Management. He has recently been named to the Editorial Board of the Journal of Business Research and a Contributing Editor to the Journal of European Research.

And now for news of other classmates: Tom Arnold has been appointed Department Head of a circuit and program design section at Bell Laboratories in Holmdel, N.J. His work involves an electronic switching system which automates some of the functions performed by long distance operators. . . . Patricia Crowther and her husband Will are currently chief cartographers for the Cave Research Foundation. . . . Margaret MacVicar. Assistant Professor of Physics at M.I.T., was selected as the first recipient of the newly-established Class of 1922 Career Development Award. The Award will be used to provide term support for young faculty members in the development of excellence in teaching. . . . John Prather is a manager of quality control at R.C.A.'s color television plant. . . . Gary Rauch is a senior engineer at Westinghouse Electric Corp., Research Laboratories in Pittsburgh. Gary is married and has one son.

Anthony Robinson has finished his psychiatry residency at Boston University and is now stationed at the Wright-Patterson Air Force Hospital. . . . Albert Teich is Director of Science and Technology Studies at the Policy Institute, Syracuse University Research Corporation. He is on the faculty at Syracuse University and the University of New York, and has authored several major publications on technology. . . . Magne Wathne received his Ph.D. in environmental engineering at Johns Hopkins and is now an assistant professor in the Regional Science Department at the University of Pennsylvania . . . Nancy and Ralph Zimmerman became the parents of daughter Mary in March of this year. Let me hear from you .- Ron Gilman, 5209 Peg Lane Memphis, Tenn. 38117

A long delay between issues and a new Alumni Fund year seem to have brought in an unusual stock of news. I'll start with the two letters that have come in recently. Joe Dyro is working in Philadelphia for the Emergency Care Research Institute as a Senior Project Engineer. Joe says the Institute is a non-profit biomedical research foundation that specializes in hospital safety surveys and the testing and evaluation of medical devices. Results of the Institute's evaluations are published monthly in the Institute's journal Health Devices. . . . Bill Judnick reports that he and his wife, the former Judith Ann White, are living in the Ann Arbor, Michigan area. Bill received an S.M. in Management from M.I.T. in 1967 and a Ph.D. in Statistics and Management Science from the University of Michigan in 1972. Bill is now an Assistant Professor in the College of Business at Eastern Michigan University. He says that he has run into many fellow alumni at bridge tournaments around the country and that the Ann Arbor-Detroit area is a bridge player's Mecca. Bill invites classmates to drop in (for bridge?) if they are passing through the Ann Arbor

Academic

There is still a lot of academic news

coming in from the Class, though I suspect that the faculty may outnumber the students by now. Pat Winston has been promoted to Associate Professor at M.I.T. in Course VI and the Artificial Intelligence Laboratory. . . Rusty Bobrow is currently living in Laguna Beach and on someone's faculty in Information and Computer Science. . . . Jim Sprinkle is finishing his second year as Assistant Professor of Geological Sciences at the University of Texas in Austin. Jim's Ph.D. thesis was published in June as a special publication of Harvard's Museum of Comparative Geology. Jim and wife Gloria are expecting their first child in December. Steve Grodzinsky has been promoted to Associate Professor of Electrical Engineering at the University of New Haven.

On the student side of the academic world, Perry Seal completed his law degree (J.D.) last June at the University of San Francisco and Mike Graham has just completed his first year of Medical School at the University of California at

San Francisco.

The Business World

I guess that summer is the time when people move to new homes and jobs. Lots of news like that this month. Class president Jim Taylor has moved from Houston to New Orleans. Jim is still with Exxon and is now in the Production Department working on employee relations problems. Jim says the new assignment is interesting but that he and Gladys have 20 per cent less house for 20 per cent more money. . . Another relocated Exxon type is **Bob Reichelt** who has been transferred from Houston to a position as Employee Relations Manager of the Exxon refinery at Bayonne, N.J. Bob says this will at least put him closer to the 'Tute. . Frank Mechura's transfer is courtesy of Continental Can. He is going to be manager of their Syracuse Corrugated Container Plant. The Mechuras have three children-Stephanie, 6, Jeffrey, 4, and Christina, 1.

People are also changing jobs in profusion—Dave Carrier left N.A.S.A.'s Johnson Space Center in Houston for Bechtel, Inc., in San Francisco. (Is there an exodus of the Class of 1965 from Houston?) Dave is working in the soil engineering department and doing his part to solve the energy crisis by making nuclear power plants safer and more acceptable. Dave says that he, Lilian and Bettina are enjoying the Bay area. . . . Gil Falk returned to Boston in June to work in the computer systems division of Bolt, Beranek and Newman. The Falks are living in Winchester. . . . Arthur Blanchard received his M.B.A. from Harvard in June and has now joined the Sea Pines Plantation Co., as an associate development manager in the residential and facilities development department. Sea Pines is a resort and recreational community builder located at Hilton Head Island, S.C. . . . Dave Crawford has returned from his two years in Leeds, England and is now working for J.I. Case Co., in Racine, Wisc., as Manager of Budgets for the International Division. Dave recommends working overseas for both professional and personal reasons.

Hank Lichstein has been named a vice

president in the First City National Bank's Financial Reporting and Profit Planning Division. Hank is still involved with the design and implementation of computerbased management information systems.

. . . Kim Kimmerling has finished his tour with the Air Force Cambridge Research Laboratory in Bedford, Mass., and is now doing research on electronic materials for Bell Laboratories in Murray Hill, N.J. The Kimmerlings live in Westfield, N.J. . . . George McKinney has been named manager of financial analysis and planning in the Treasury Division of Corning Glass Works. . . and Howie Ellis sent a note that he ran into Jim Wolf at Cleveland Airport. Howie was in Cleveland to testify in a court case on air pollution regulations for his firm Enviroplan. Jim is still with Booz Allen.

Daniel Stebbins reports that he is married and a financial analyst with John P. Chase, Inc. . . . Leonard Zacks is Director of Long Range Planning for A. G. Becker and Co., of New York City. Leonard's wife is expecting and they are looking for a house to replace their apartment in Hackensack. . . . David Disher is completing this third year as owner of Disher Consulting Service dedicated to inventing seismic exploration programs. Dave's wife Mary entered the University of Texas' School of Dentistry in June.
. . . Bob Silverstein is Manager of the Strategic Systems Project Office for T.R.W. in Washington. Bob, wife Ellen and their three children (Seth, 4, Rachel, 3, and Allison, 1) live in Potomac, Md.

Family Notes

Cathy and Mike Hester report a second son, Ryan, Born April 16. Their older boy, Bren, 2, has begun to accept him. Mike is still with Lockheed in Burbank after eight years and heads a scientific programming group specializing in reduction and analysis of flight test data. . . . Jon Addelston was married to the former Edith Faber of Franklin, Mass. in March of 1971. Their daughter, Miriam Beth was born last March 15. The Addelston's are living in Waltham, Mass. . . . Etta and Mike Gabel had their first child, Jonathan Louis, born last April 29. Mike is still Assistant Professor of Mathematics at Purdue. . . . Aaron Goldberg sent a note written as the movers were carting out the boxes for the move to the Goldbergs' new house in Framingham, Mass. The move was precipitated by Aaron's wife Ellen presenting him with a daughter, Deborah last October. Aaron is an Engineering Specialist for G.T.E. Sylvania in Needham, Mass. . . . George Kossuth reports that daughter Mary Beth was born on July 30, 1972. The Kossuths also have a son, Jonathan, 3. They moved to Melrose, Mass., in June of 1972. George is still with the Draper Lab.

Alumni Doings

Harry Movitz has been elected President of the M.I.T. Framingham Alumni Club. . . and the attendees at the 1973 Alumni Day included Ralph Gerenz, Scotty Mac-Vicar, Leo Rotenberg, Dan Stebbins, and Ron Wilson. (Scotty MacVicar may be Class of 1964—that's when she graduated-but was registered at Alumni Day with us.)

And that is a better collection of letters than usual. Keep them coming.—Steve Lipner Secretary, 3703 Stearns Hill Rd., Waltham, Mass. 02154

Summer brought with it many letters and cards along with a load of news from

the 'tute. Many thanks!

I still have two letters from late last spring which arrived after the last deadline. Saul Mooallem wrote "In 1968 I received a master's degree in Computer Science from the University of Waterloo here in Ontario. Last October I married Susan Hendlin of Springfield, N.J., and we live in the Toronto suburb of Mississauga, where I am working in computer software development at Control Data." Saul's letter arrived in March but did not set the record for belated news. A letter from Michael Marx arrived this week but was dated in early February of 1972! He wrote, "last May(?) Sue and I celebrated the arrival of our second child. Then this past fall I decided to abandon the sinking ship called the aerospace industry. I have left Lincoln Laboratory and joined a small management consulting firm called Technical Marketing Associates located in Concord. So far this venture has been a delight." I always feel bad when a letter misses an issue but to receive a letter a year and a half late has got to be the all-time record.

In other, more current letters "Bryan Pearce is back at M.I.T. as a research associate in the water resources division of Civil Engineering after completing his Ph.D. at the University of Florida in 1972. He and his wife Deta and son Nicholas now live in Arlington." From Judith Risinger Perrolle, "I more or less shut down my consulting business this spring to become East Coast Coordinator of the Committee of Concerned Asian Scholars. The trip from computers to Asian scholarship was somewhat complicated . . . the experience of being a technical advisor in Asia was enough to make me give up things technical for studying Asian societies. I have a Danforth Fellowship for Women which will enable me to start graduate school at Brown in the Sociology Department. . . . Pierre is teaching Chinese politics at Wheaton College and finishing up his dissertation on Transportation Policies in Post-Liberation China. Jeanette goes to nursery school and does typical five-year-old things."

Paul Rudovsky is still at Citibank. "I am still single and living in Manhatten. I have been in touch with Steve Disman and Henry Lichstein, '65, both of whom work for Citibank. I've also seen Professor Mundel and Larry Calof (Larry is an attorney in Los Angeles-married with one son)." . . . Jerry Abraham reports that he and his family are doing well and he is enjoying his work at the Public

Health Service.

T. Richard Schmidt sent a particularly long note-"After graduation I attended the University of Virginia in Charlottesville. It has an architectural layout similar to M.I.T.'s with rotunda and lawn and surrounding buildings corresponding to the Great Dome and Court. This is not surprising, though, when you consider that William Barton Rogers had been Professor of Natural Philosophy at U. Va. In August, 1969 I married Jeanne Ann Damon from Wyoming. Jeanne and I had met the summer of '65 in Pasadena. After completing most of my studies at U. Va. in 1970, I accepted a position as Assistant Professor of Chemistry at Olivet Nazarene College in Kankakee, III. I went back to W. Va. the next summer to finish my dissertation and receive a Ph.D. A son was born to us on September 14, 1972. His birth announcement read 'Chemist Creates Life!' '

I finally heard from John Bailey Adger who wrote from Medan to ask "where is Franz Birkner? John Freeman told me that Franz went sailing with a bunch of kooks a couple of years ago and had not been heard from since . . ." Franz is doing well working for a small company in San Diego. . . . Dave Vanderscoff has found an efficient way to commute to New York City from Long Island. He recently enrolled in the M.B.A. program given by Adelphi University on the Long Island Railroad. . . . Paul Branstad has relocated to Boston from Los Angeles to work as a management consultant with

the Boston Consulting Group.

William Schnicke reports that for this upcoming year he will be serving as treasurer of the Berwyn School P.T.A. as well as treasurer of the Operations Research Society of America. Tom Scott has been working for a recording studio in Hollywood since the end of his Peace Corps tour. In September of 1972 he moved north to San Francisco to manage a studio in Sausalito. He just bought a house in Mill Valley but reports that he is still single. . . . Uday, Sukhatme writes that "after a very pleasant two-year stay in Seattle, we will be moving to the University of Michigan in the fall." He has accepted a postdoctoral research position in the physics department. . . . Stan Horowitz is working as an economist at C.N.A. His work involves evaluating manpower training programs for the Labor Department. . . . Allen Inversin is ending up his fourth year with International Volunteer Services as a teacher of physics and math in Laos. He intends to spend some time encircling the globe with a visit to the United States in the fall. Dennis Sivers writes . . . "our stay in Illinois while I've been working for the high energy physics group at Argonne National Lab., was highlighted by the birth of a daughter, Heidi Ann. This past summer we moved to Palo Alto where I started a research associate position at the Stanford Linear Accelerator." . . . Bob Mohr worked for a summer as a Forest Ranger in the Rocky Mountain National Park. He reports that it gave him a chance to "breathe fresh air and eat soggy scrambled eggs."

Victor Rosenberg left his position as Vice President of Chesapeake Life Insurance to become a financial analyst with Xerox. . . . Peter Brown is currently working in the surface Transportation Systems Department on the Technology Staff. Recent programs include the winning bid on the Boston-San Francisco Light Rail Cars and testing of a Rapid Transit car in Pueblo, Colo.

That's it for now. . . . remember me when you're sending out cards at the end of the year.-Tom Jones, Secretary, Apt. 6, 59 Commercial Wharf, Boston, Mass 02110

During the summer I worked as a law clerk with the Phoenix law firm of Jennings, Strouss and Salmon, and in spite of the heat, Shar and I enjoyed the outdoor life in Arizona. Now it's back to the books and a few more months at Stanford. . . . Barbara and Erich Hespenheide were blessed with the birth of their second child, Mark Andrew, born May 8, 1973. . . . Mike Rosenblum and the former Kiki Kouner recently celebrated their first anniversary. Mike has an enjoyable job selling textiles, and Kiki attends Pratt Institute in Brooklyn. . . . Walt Rode works at Polaroid in Cambridge. . . . Alan Gevins is Systems Director at University of California Medical Center where he is continuing consciousness exploration in the form of real time E.E.G. analysis systems. . . . June Paradise Maul attends Rutgers University and is an administra-tive assistant at Gill/St. Bernards High School in Gladstone, N.J.

Jim Duclos received a Doctor of Philosophy degree in Chemistry from Wesleyan University. . . . The following attended Alumni Day at M.I.T.: John Acevedo, Larry Burgess, Louis Goldish, Bruce Ressler, and Neil Steinmetz. . . . Tom Brownscombe received a Ph.D. in Chemistry from Rice University last May. . . . Alan Kruse received an M.S. in Chemistry from

lowa State University.

Ross Corotis, Professor in Civil Engineering at Northwestern University, has been awarded a \$17,000 National Science Foundation grant to develop a statistical probability model for improving flood-level prediction. The 18-month research project will combine existing rainfall and runoff level data into a predictive model more realistic than those presently used. The model will permit better design of drainage facilities and flood control devices. . . Peter Young has been commissioned a second lieutenant in the U.S. Air Force and is assigned to Edwards Air Force Base, Calif. . . . Jim Williams, Assistant Professor of Mechanical Engineering at M.I.T., was given an Everett Moore Baker Award for outstanding undergraduate teaching.

Gary Powell is in a Ph.D. program in business administration at University of Massachusetts. He spent some time "T-Grouping" it in Bethel, Maine this past summer. . . . David Underwood and his wife, the former Cynthia Lyons, are living in Rochester, N.Y., where Dave is a research associate in physics at U. of Rochester. They have a year-old son Gabriel.

Gary Epling has accepted an offer of an assistant professorship in chemistry at Fordham University. . . . Nathan Teichholtz has a daughter, Holly Ann, born April 15, 1973. He attended the wedding of Bob Katz to Linda Lago on June 23. Bob and Linda are living in Brussels where Bob is selling computers .- Jim Swanson, Secretary, 11567 Circle Way, Dublin, Calif. 94566

Welcome back again after a long summer. Hope that you all were able to take a nice vacation in the past few months. We escaped the Washington heat by going to Scandinavia for a month where I gave a paper at the International Teletraffic Congress in Stockholm. We then toured the countryside and even got up to the Arctic Circle in Finland, but now we're back again to our nation's capital.

Academic Accomplishments

From exotic Cambridge Mass., Richard Melson writes that he is a Graduate Prize Fellow in Asian Studies at Harvard. He has won the Sheldon Prize and a Fulbright, and his doctoral thesis will probably be on U.S.-Japanese business, past, present, and future. On the side, he has established Melton Technical Translations, Inc., in which he usually does the French, German, and Japanese himself. He is interested in reestablishing contacts with classmates. . . . At Stanford, Mark McNamee recently completed a doctorate in Chemistry with a thesis entitled "Spin Label Measurements of Transmembrane Potentials and Phospholipid Flip-Flop in Excitable Membrane Vesicles". He is now a postdoctoral research associate at the Department of Neurology, College of Physicians and Surgeons, Columbia University. . . . Steve Gamer received an M.S. from Rutgers in June. . . Last year Gene Stark completed his doctorate and he is now working in research and development of large laser systems at Los Alamos. He writes, "My wife, two young sons, and I are flourishing in the uncluttered southwest." . . . Someone else has also found an uncluttered place to live. Phil Weidner finished Harvard Law School last year and has been living in Juneau, Alaska in a cabin on the ocean where he has been clerking for the Alaska Supreme Court. In September he joined the Alaska Public Defender Agency in Anchorage. Phil writes, "Alaska is a crazy place. Some drawbacks due to the isolation, but the beautiful country and the sense of vitality one receives from it are adequate compensation. Lots of room up here for anyone interested. P. S. A whale jumped all the way out of the water the other night in front of my cabin. I see whales, sea lions, otter, eagles, regularly. Also a lot of tourists now that the snow is gone." . . John Kiuper has finished a Ph.D. in the Engineering-Economics Planning program in Civil Engineering at Stanford. He now works in the Power Resources Planning Division of Harza Engineering and reports that the windy city is nicer than he expected. . . . Putting his Harvard M.B.A. to good use, Bill Ohm joined Ross Controls, a four man computer peripheral company where he is now Vice President-Operations. However the firm recently received major backing from American Research and Development so he expects rapid expansion. On the more personal side, Bill reports that he married the former Nancy Gillis of Cambridge in July. . . . John Wertz received a J. D. degree from B.U. last June. . . . Finally I have two notes dated last spring about people who said their doctorates were imminent. So we hope everything went well and that Don Fye received a Ph.D. in Electrical Science from Brown and Burt Rothberg received a D.B.A. from Harvard.

Corporate Careers

After four years in the navy and an M.S. in Computer Science at George Washington, Bob Roach is back in the free enterprise system in the Financial Reporting and Profit Planning Division of First National City Bank in New York. He reports that if you order an Amtrak ticket by mail and get back a computerized coupon, you've used a system he worked on. . . . Bob Condap is now Vice President in change of marketing for Flex Key Corp., a volume manufacturer of patented conductive elastomer keyboards in Gloucester. . . . William Zink has joined Eastern Gas and Fuel Associates as a systems analyst in the Management Information System Department in Boston. ... Betsey and Bob McCrory have moved to Los Alamos where he is working in the Theoretical Design Division.

Finally we have received news that James Ward died very suddenly from natural causes in Paris Last September. He had been working in Paris for Burroughs. Jim was a native of Quincy and had majored in math. We wish to convey our sympathies to his family and friends.-Gail and Mike Marcus, 2207 Reddfield Dr., Falls Church, Va. 22043

I have quite a stack of letters and notes from classmates for this installment of the Class Notes so without further introduction, let's begin. . . . Peter Kleeman is currently in the Environmental Science and Engineering program at Harvard University. After receiving his M.S., Peter expected to continue his studies in pursuit of a Ph.D. . . . James Scott Rhoades and his wife are the proud parents of a new daughter Carrie Delaney. Jim is currently enrolled in the graduate program at M.I.T. in course XVI and is a research assistant at the Draper Laboratories. . John R. Smith has received his M.S. from the University of Southern California and is living in Huntington Beach, Calif. John writes, "After years of looking down on business majors, guess what-now 'I

The research efforts of Henry Miller at University of California-San Diego have earned him national recognition and honors. Henry was awarded the second place "excellence in research" award at the Thirteenth Annual Student American Medical Association-University of Texas Medical Branch National Student Research Forum. His research consisted of identifying and characterizing a previously undefined bacterial enzyme-Ribonuclease H. His work may enable researchers to find a means of interrupting bacterial growth thus providing a new point at which treatment of disease would be possible. In the meantime, his wife Jerry Miller received her M.D. from U.C.S.D. on June 10, 1973. Henry will receive his M.D. degree in June of 1975. Jerry is now an intern at the University hospital in "straight medicine." Both Henry and Jerry report they are enjoying life in San Diego. . . . Carol E. H. Scott reports that her experiences in medical school are quite a change from engineering. Carol likes what she has seen of New York City but wants to return to New England after graduation from medical school. . . . After being married on August 1, 1971, Charles T. Hudson and his wife were expecting their first child in May of this year. On the academic side, Charles received his M.S.E. in December of 1970 and is now employed as a systems programmer for a time-sharing firm located in Ann Arbor, Mich. . . . From the land of the metaphysical, Peter Georgi reports that he is teaching transcendental meditation and the science of creative intelligence full-time for the International Meditation Society. The Society founded by Maharishi Mahesh Yogi.

Noble Larson is now married to Susan Waldman. Susan teaches in Boston while Noble works on computers as a logic designer for Honeywell in Billerica, Mass. Their home is in Methuen, Mass. . . . B. G. Leslie is still working for and studying at the 'tute. He reports that he is "proud to be from Massachusetts" . . . While studying law at Seton Hall Law School, Paul Kudirka is a member of the patent staff at Bell Telephone Labs in Murray Hill, N.J. . . . Carolyn G. Debrick completed medical school at Harvard University in June of this year. She is now a resident in radiology at Massachusetts General Hospital. . . . David D. Jackson is teaching planetary and space science at U.C.L.A. and says "hi" to all his old friends from M.I.T. . . . On March 30, 1973, Richard L. DeVries left the active U.S. Coast Guard to become a reservist. He now works for Bath Iron Works in Bath, Me., in the production planning department.

After completing three years of teaching in a Quaker boy's school and earning an M.A.T. from Temple University, Frank Guillot has returned to architecture. He has been sculling and competing actively in rowing. Last summer, Frank went to the Olympic trials in the double sculls event but failed to qualify although he enjoyed the experience. . . . Stephen Dreher is working for Gates Rubber Co., in Denver as a programmer-analyst. Steve writes that Don Vawter is presently working towards his Ph.D. at U.C.S.D. in bio-medical engineering. He would also like to know what has happened to John Gruenstein. . . . Carl R. Bozzuto has recently been promoted to section manager of fuels technology at Kretsinger Development Laboratories of Combustion Engineering. . . . After three years as a process engineer with Foster Wheeler Francaise in Paris, Patrick J. Vayn came back to the U.S.A. last year to enroll in the M.B.A. program at Harvard Business School. . . . Carl Everett is still in law school at the University of Houston and expects to receive his J.D. this December. He is also enrolled in an air pollution control program which will yield either an M.S. or M.P.H. from the University of Texas Public Health School by June of next year. Carl hopes to find employment after that in some environmental law capacity. . . . David Ross Hunter is teaching mathematics at Wellesley High School.

Larry Stelmack is now living in "beautiful downtown Winchester, Mass, and looking for work in holography." Larry states he "was considering getting together with some of my old Burton House buddies to pull a 'last great hack', but what could we do to top Watergate?" . . Since receiving his M.B.A. from Harvard Business School in June of 1972. Larry L. Lowry has been employed as a management consultant with the Boston Consulting Group, Inc. . . . Joel Morgenstern has been teaching biology, general science, and chemistry at Louis D. Brandeis High School for the last three years. The school is located on New York City's west side which has given Joel an opportunity to create good programs and classes to counter some of the problems of a typical city school. Joel has contributed a course called "Biology Pre-Med" for students interested in pursuing a medical career. In general, he has found teaching to be "exciting, interesting, and frustrating-not necessarily in that order." . . . Joseph F. Simeone graduated from Yale Medical School with his M.D. in June of this year. He is currently a resident in diagnostic radiology at Yale-New Haven Hospital. . . . William P. Mitchell is working as a programmer-analyst at the laboratory of computer science at Massachusetts General Hospital, Bill still hangs around WTBS and does an occasional newscast.

Hal R. Varian, a recent Ph.D. recipient from Berkeley, has been appointed an assistant professor in the department of economics at M.I.T. for a period of three years. . . . Barry D. Milder received his M.D. from the Washington University School of Medicine on May 25, 1973. Barry has entered the practice of medicine as an intern in medicine at Baylor College Affiliated Hospitals in Houston. . . Sanford J. Asman has joined R.C.A. Patent Operations at the David Sarnoff Research Center in Princeton, N.J. Having graduated from New York University School of Law in 1972, he is now a member of the New York Bar. He and his wife Sheryl live in Cranbury, N.J. . . . Attendees of Alumni Day activities this year included Melvyn Basan, John Brown, Josette C. Goldish, Wayne C. Huber, Alan R. Millner, Mark A. Rockoff, John D. Schmitz, and Robert M. Supnik. . . .

George C. Slusher has bought another horse, this one a four-year old Morgan mare named Vigilady, which is expected to be a very good show and pleasure horse. He hoped to be showing her in Morgan shows, dressage shows, and some others this past spring and summer. He has gone into the horse business in earnest, having also purchased an old '65 pickup and a used trailer. He is also looking for a pleasure cart and harness. Among his Air Force activities is that of member of the aeronautical systems division's junior officer's council, representing the flight dynamics laboratory. His job includes the ground testing of the sight-line auto pilot for the AC-130E gunship which is a sophisticated control system using an existing on-board digital computer to hold the aircraft's guns on target more precisely than a human pilot can. The technology involved in the design and testing of the control system will have applicability to many other systems.

Michael Riley is working as a mathematics teacher in The Group School-an alternative high school for lower income students in Cambridge, Mass. The school has been certified and has about 50 students. The budget for math and science programs comes mostly from the M.I.T. community service funds. Mike and his associates have been developing classes that are small and appeal to people who do not like math. They have a Wang calculator on loan which is being used in the math lab. It has been instrumental in exciting many students. If anyone would like to donate to the school, they should contact Mike at 66 Winthrop Street, Cambridge, Mass. 02138 (612/491-4884). . . . Ron Skellenger is having a good time teaching a Head Start class for four and five-year olds in Bolinas, Calif., and would like to hear from the classmates with whom he has lost contact. . . One final note-if anyone is interested in receiving the 1969 Technique, requests should be directed to M.I.T. Branch P.O. Box 5, Cambridge, Mass. 02139.-Richard J. Moen, Secretary-Treasurer, W-1781 First National Bank Building, Saint Paul, Mn. 55101

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We've got lots of news this month, so, without further ado, Joel S. Davis is still a graduate student in Astro-Geophysics at the University of Colorado, and is currently teaching General Astronomy under a teaching assistantship. He was going to get onto a Radio Astronomy research project, but funding cuts, leaving two positions for five contenders, make it very uncertain. Joel is almost recovered from being hit by a car (drunken driver) last year, although he still limps somewhat. . . . David H. Hall is still "plugging away", trying to get a research program going for his Ph.D. in Biochemistry at CalTech. He's spent most of his time "staring at nematodes-not always very rewarding." David's wife, Nancy, is just finishing her work for a master's in Biostatistics at U.C.L.A. . . . Srinivasa Murthy, a doctoral student at Harvard Business School, is expected to finish this year. . . . Monroe N. Benair is starting his last year of medical school. . Howard Manasse is at Downstate Medical Center, going into his second year of an M.D. program. "Doing fine." Last year, Howard left a doctoral program in chemistry at Harvard early, and "took a master's degree with me." . . . Mark A. Novack received his M.D. degree in May from Washington University School of Medicine in St. Louis. Mark will be staying in St. Louis to intern at St. Luke's Hospital. . . . Bernie F. L. Ward received a Ph.D. in physics from Princeton in June. He also picked up an M.A., and was an instructor during the spring of 1973. Bernie will be a Research Associate in Theoretical Physics at the Stanford Linear Accelerator Center. His special interest is the theory of inelastic lepton

nuclear scattering.

Jimmy J. Jackson, who separated from the Air Force on June 30, will be returning to M.I.T. to earn a master's in Management. . . H. Jory Kesten just completed his studies at Osgoode Hall Law School in Toronto. . . . Robert A. Barr received his J.D. in June from Boston University School of Law, and will be a teaching fellow at Berkeley Law School of the University of California. . . . Joan Etzweiler passed her qualifying exams, and is now a doctoral candidate in nuclear engineering at the University of Wisconsin at Madison. We received a lovely letter from Tony Picardi, who brings us up to date on his life during the past year. In May of '72 he passed his doctoral exams for an interdepartmental program at the Institute. The program is centered in the Civil Engineering Department and has to do with the analysis of complex social, economic, and environmental systems. In June of '72 he received his master's in Civil Engineering. Since then, Tony has been looking for support for his doctoral thesis and working as a research assistant with Professor William Mathews (Civil Engineering Department) on a technology assessment methodology for toxic chemicals in the environment. Luckily, thesis support seems imminent—it looks as though, by the end of the summer, he'll have started a project dealing with longterm water resource development in Saudi Arabia. In May, he had an article, based on his master's thesis, published in an "esoteric journal" called Simulation; he will soon trundle off to Montreal to present another paper at the Summer Computer Simulation Conference. Tcny's wife Shirley just finished her master's degree and doctoral exams in May, so they took off in June on a long-awaited trip to his parents' farm in Virginia, and then on to California. They "sampled generously of the native wine, hiked and camped in Lassen and Yosemite National Parks and generally grooved on trees and birds, a rare commodity in Cambridge.' As of July, Tony and Shirley were suf-fering from "the post vacation-pre-thesis blues, which can only be cured by some serious sailing on the Charles . . . and . who knows, maybe a quick jaunt to Saudi Arabia." navy, working as the Supervisor of Shipbuilding, Poscagoula, Miss., on the Navy's

Gary R. Laughlin is a Lieutenant in the Multipurpose Amphibious Assault Ship (L.H.A.) being built in Ingalls Shipyard, Poscagoula. . . . Donald L. Tymchuck is presently with General Mills Chemicals, Inc., affer leaving Hydroculture, Inc., of Glendale, Ariz., in January, 1973. . . . Jeffrey W. Jordan recently transferred from the Washington, D.C., office to the San Francisco office of Booz Allen and Hamilton, where he works as a consultant in the Health and Medical and Social Services Management fields. Jeff would like to hear from San Francisco area alumni. . . . Robert F. Mohl spent the summer "designing the sound system in his hot air balloon for low altitude multimedia presentations. The visual portion, utilizing curved screen and interior projection, has just been tested over San Francisco. He thought the test went "ex-

tremely well." . . . John A. Friel spent 1970-72 at Harvard Business School. He and his wife, Elaine, are presently living in Silver Spring, Md. John is Manager of Portfolio Operations, Office of Finance, Federal Home Loan Banks, in Washington, D.C. . . . Steven Gregory just finished his first year as an assistant professor of architecture at the University of Utah. . . . Arthur B. Barrow and his wife Leslie, who are living in Salem, N.H., are "happily busying ourselves in preparation for the birth of our first child (around October)." Arthur works as a microprogrammer for Wang Laboratories in Tewksbury, Mass. . . . Philip M. Dorin, who is living in Los Angeles, holds an assistant professorship in the Department of Electrical Engineering and Computer Science at Loyola University. His wife Lois expected their first child in July.

Phil also sends news of other classmates: Claire and Ralph Brindis are leaving Los Angeles for Atlanta in August; Ralph will be attending Emory Medical School. . . . Barry Bochner is still working on a Ph.D. in Bio-medical Engineering at the University of Michigan at Ann Arbor. . . . Randi and Chris Rose are still living in Brookline. Chris just finished his third year at Harvard Medical School. . . . Alan Chapman is entering Yale in the fall to work for a Ph.D. in Music Theory. Alan, by the way, has a new image these days: but, true to his old style, he informs us that "if any fellow alumnus is in the New Haven area, he can stay away.'

Thom O. Bales, Jr., just began work in Miami with Cordis Corp., as a Manufacturing Engineer in bio-medical instrumentation. Thom, who is sharing a house with Bill Box, '69, spent the last year and a half in the army in Germany. . . . Lee K. Fox is getting married on September 2 to Adrienne Smith (Wellesley '73). Lee is working at A. D. Little in Cambridge in Solid Waste Management. . . . John M. Tuohy, Jr., was married on June 6, 1970; his first child, Kathy, was born on Dec. 1, 1971. As of May 20, 1973, John was employed at Burns and Roe Inc. with the first commercial fast breeder reactor.

We received a long letter from Richard T. Greene which I wouldn't dare to try to summarize-so I'll just quote most of it: "It's hard for me to believe my life lately. After spending all morning brainstorming renewal strategies for 40 year community renewal in Chicago, at a hamburger bar across the street, an old wrinkled lady drops her new orange patent leather pocketbook and in picking it up mutters a short course on 'these times. . . . can't hold on to anything . . . kids wheezing on the sidewalk just like us old people . . . leaders, Nixon and all, don't know any more about it than we do . . . some of us are going to have to begin something!'

"Each day, struggling with how to do many things deeply; I spend 8-5 selling computer systems for Burroughs, lunch hours teaching "Methods of Teaching" at YMCA College, 4 a.m. to 8 a.m. at the Ecumenical Institute breakfast collegium and 6 p.m. to 11 p.m. strategizing how to release the global renewal that's going on over the next 20 years, at Ecumenical Institute workshops. Wild activity has become such a daily norm that

I'm now experiencing it as great Peace. I'm not as great as I was five years ago, but life is becoming more wonderful (slowly). "As I look at people, a deep new kind of hope is emerging, and I experience the burdensome pain of building the New out of the very stuff of the old at Burroughs, at the Banks I visit to sell to, at the Y.M.C.A. classroom of 35 forty-year-old ladies' from the ghetto, at the Institute meetings across North America. Something deeply New may be emerging, and in the practical work of each day people are more and more feeling the obligation to respond to it, give it form, risk creating the future. Sometimes that seems like an abstraction to me, then at other times, I'm clear that is more real than the baggage of political opinions, vacation plans, hobbies I keep finding myself filling up my time with. "I'd be interested in seeing, in some form, a listing (not a profile some abstractionist has analyzed) of who our class is today, and where it is, and where each member sees himself going with his future. Can such lists happen?" Only if our classmates are willing to write and let us know. That would make the mailbag happy, too. (Sneaky plug.)
Alumni Day activities have been re-

ported on elsewhere in Technology Review, so we won't go into detail (especially since we weren't there). Our class was represented by George C. Allen, Jr., Elaine Gruber, and William F. Mayer. Your secretary was, however, at the very interesting convocation honoring 100 Years of Women at M.I.T. ("Focus on the Future"), and noticed that the only other member of our Class in attendance was Laurie Nisonoff, who is working on her thesis for a Ph.D. in economics at Yale. (Apologies if I've overlooked anyone else who was there.) However, Mc-Cormick 7th floor West was very well represented.

The final word for this month is that your secretary has moved, although not very far away. Please note the new address, so that all the lovely letters you're going to write will reach me quickly .-Laura Malin, Secretary, 82 Munroe St., Apt. 1C, Somerville, Mass. 02143

Returning from a delightful weekend tramping about Mt. Katahdin with Maury Goodman, I find myself in the pleasant, unprecedented, and probably transitory state of having quite a pile of news for this month's column. We had a magnificent clear day at Katahdin's summit and, in spite of "scattered showers" which thoroughly drenched us the following day, we had a grand time. Maury, by the way, is now a grad student in Physics at the University of Illinois at Urbana.

Elsewhere in the academic world, Michael Errecart is doing graduate work in operations research at Johns Hopkins. . . . Nathanial King received his S.M. in Ocean Engineering from the Institute in September. . . . James Bartis is a research associate in Chemistry at Cornell. . In England, Theodoros Achtarides is at the University of Newcastle-on-Tyne studying Naval Architecture. . . . Andrew

Lazarewicz writes that he is studying for an M.S. in astronomy at the University of Hawaii. "The diving is fantastic, but I miss snow!-also the cheaper prices." . . . Steve Clarke has received his master's in math from the University of Maryland and is continuing for his doctorate. . . . Larry Bacow has completed his first year of the public policy program at Harvard and has just entered the Law School. He spent the summer working for the Rand Corp. . . . Harvey Baker, after a summer working in Washington for the U.S.I.A., is in his second year at Harvard Law.

Still in Cambridge, Joe Clift is an economist for the Department of Transportation . . . while Kenneth Belovarac is an analyst and economist for the Raytheon Service Co., working at D.O.T. . . . Also in transportation, Frank Garofolo is working for the Scientific Research Labs at Ford in Dearborn, Mich. He just finished his work in computer information, and control engineering at the University of Michigan. . . . John Halkyard reports that he is Senior Ocean Engineer for Kennecott Copper responsible for the development of deep ocean mining equip-

Rafael Fernandez has recently moved from Dupont to the Westinghouse Tampa Division and is working on nuclear power plant components. . . . Rocky Richard Arnold writes that he is "working as a structural analyst at the United Technology Center of United Aircraft. Major company efforts have been development of the Trident Underwater Missile and Space Shuttle Work.

We have three marriages to report this month. In May Tom Schamp married Virginia Demetriou, a senior at Simmons in physical therapy. Tom has received his master's in Course XVI and is now working on a strapdown inertial navigation system at Draper Lab. . . . Richard Na-thanson was married last January to Judy Lynne Apt, another Simmons girl. Thomas Bissell writes, "Just married in December to a great gal, an airline hostess for T.W.A. I'm working for United Nuclear Corp., in quality control and hope to soon move into a one room log cabin right by a lake-back to nature after four years in Boston."

Among less usual activities, William Brotherton writes "I have been playing back up bass for the new 'Dead' album to be released." . . . Rick Nelson is working as a full-time preacher as a Jehovah's Witness. . . Arlene Fingeret, who is co-ordinator of adult education services at the Education Warehouse in Cambridge was nominated for membership in the M.I.T. Corporation. . . . Dave De-Bronkart writes, "What else do you do with a degree in, essentially, organiza-tion studies from Sloan? You teach I.B.M.'s typesetting system in the (disorganized) print shop of a vocational school for handicapped kids. You drive a (disorganized) car called the Awfulmobile. And you wonder what 'organized' means."

I regret to have to report the death of one of our classmates. Leroy Besone was killed in an automobile accident last April.-Dick Fletcher, Secretary, West St., Braintree, Mass. 02184

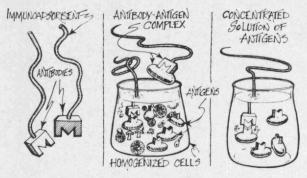
Technically intriguing items from TRW, guaranteed to add luster to your conversation and amaze your friends.

Disarming a Virus You, a teenager with mononucleosis, and an African girl with a cancer called Burkitt's lymphoma have one thing in common. Your cells very likely contain a "living molecule" called the Epstein-Barr virus (EBV). But you are in no danger, the teenager will recover from a long and exhausting illness, and the African child may die. Why?

Viruses and cancer are frequently associated, but we don't know much about their exact relationship. Is cancer caused by the virus or by a combination of factors? What makes people react differently to the same virus?

We know that when an organism fights disease it produces antibodies which travel through its bloodstream combining with and deactivating the foreign chemicals, called antigens. But antigens are not only viruses or virus products. The virus-transformed cells themselves make antigens which can cause or contribute to their destruction. When cells are invaded by EBV, five different antigens may be formed.

To best study the properties of antigens, we must separate them from all the other materials found in cells. One way is to use immunoadsorbents, long-chain molecules to which EBV antibodies have been chemically attached. EBV-infected cells are homogenized and the immunoadsorbent is immersed in the mixture. The antigens cling to the antibodies and when the immunoadsorbent is removed, the antigens come with it. The antigens are then freed from the immunoadsorbent and concentrated.



Scientists at the National Cancer Institute hope to isolate EBV antigens and those of other cancer-associated viruses. These antigens could be used to produce serums which would be catalogued and stored in a serum bank. Each serum would contain the antibody to one specific antigen. TRW researcher Dr. Norman Weliky has been perfecting the immunoadsorbent technique for the National Cancer Institute. His group has prepared a highly purified serum against a mouse leukemia virus, and is now working on EBV-associated antigens. Their work is a small but important step toward the solution of the cancervirus mystery.

Boomerang Have you ever considered how many hazardous chemicals get into our environment via their containers alone? Paint residues left in the cans and carted to your local dump add 32,700 pounds of mercury, 4.4 million pounds of lead, and 1 million pounds of chromium to the earth and water each year. And what about the packages that held pesticides like dieldrin and herbicides like 2,4-D? How do you clean the solvent that washed the can that contained the powder that killed the bugs that ate the wheat that farmer Jack grew?

The Environmental Protection Agency realized that we don't know enough about hazardous chemicals and their disposal. For instance, mankind has been using the oceans as an ultimate disposal site for centuries without knowing the effects of waste materials on the ocean environment.

TRW Systems was asked to help. In a year of investigation we have compiled and studied a rouges' gallery of over 500 chemicals which are highly toxic, persistent, extremely flammable or explosive, or radioactive. We have also recommended ways of dealing with these ecological menaces, usually by breaking them down completely or isolating them from the environment.

Waste can be like a boomerang; you think you've thrown it away, but it returns, sometimes with destructive force. TRW is working with the EPA to improve waste management techniques in the United States. You should go to the dump, but the dump shouldn't come back to you.

For further information, write on your company letterhead to:



Attention: Marketing Communications, E2/9043 One Space Park Redondo Beach, California 90278



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